

# Safe and Effective Carbon Dioxide Laser Skin Resurfacing of the Neck

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CO<sub>2</sub> laser skin resurfacing remains the gold standard for treatment of photoaged facial skin. It can be used onto the neck to further blend in the treated area with non-treated, adjacent photodamaged skin as well as improve the superficial textural quality of the neck skin. This article provides an overview of laser skin resurfacing of the neck, including pre-operative evaluation, patient education and selection, laser settings and technique used, post-operative care, and identification and treatment of possible complications. *Lasers Surg. Med.* 38:653–657, 2006.

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## INTRODUCTION

Carbon dioxide (CO<sub>2</sub>) laser skin resurfacing utilizes a rapidly pulsed carbon dioxide laser system to treat photodamage by removing the epidermis, as well as by thermally inducing changes in the dermis [1]. A multi-center clinical trial, utilizing the Coherent (Palo Alto, CA) UltraPulse® 5000 CO<sub>2</sub> laser, demonstrated safety and efficacy for facial skin resurfacing. As one of the original clinical trial sites, we studied the safest and most effective way to utilize the device. During the course of the original study, we determined that the use of a topical anesthetic cream, EMLA (Eutectic Mixture of Local Anesthetics (lidocaine and prilocaine), Astra, Westborough, MA) provided good topical anesthesia. In a later evaluation we studied the clinical utility of extending laser skin resurfacing from the face onto the neck in an attempt to better “blend” the laser-treated areas with adjacent non-treated skin. With time, we also appreciated that the topical application of EMLA helped protect the skin through its hydration properties. Utilizing this pre-operative hydration, selecting lower energy densities, performing a single laser pass, and leaving the epidermal debris intact led to a safe and effective CO<sub>2</sub> laser skin resurfacing of the neck. Over 1,500 CO<sub>2</sub> laser resurfacing procedures of the neck have been performed in this manner at our center with only two patients experiencing mild hypopigmentation.

## PATIENT CONSULTATION

Patients are advised that fine wrinkles and acne scars improve more than deeper lines. Accumulated superficial sun-induced changes, such as solar lentigos and actinic keratoses, respond better than deeper lesions which may recur if a dermal component is unable to be completely

removed as with dermal nevi and adnexal tumors. Patients are screened for any tendency to keloid, history of herpes simplex virus (HSV), yeast infections, or any other underlying illnesses that may affect healing or pigmentation (see below). Smoking is strongly discouraged. The procedure and perioperative care is fully explained as well as the potential risks, benefits, and other treatment options. Careful photographs of the areas to be treated are taken to document the pre-operative state. These are helpful for comparison in the post-operative period to show improvement as well as document any pre-existing conditions.

Over 99% of our neck resurfacing cases were treated concomitantly with facial resurfacing. In nearly all cases, if a patient is a candidate for facial resurfacing, the neck can be treated as well. The few neck resurfacing only cases were those referred to us to help blend the sharp demarcation that remained from previous facial resurfacing (done elsewhere) with the untreated neck. Prior radiation treatment in the lower neck was the only case of ours that precluded laser resurfacing. We were concerned that the decreased adnexal structures seen with radiation changes may increase the risk for scarring. Our only other absolute contraindication for face or neck resurfacing is a personal or immediate family history of vitiligo which is associated with the Koebner phenomenon. Areas that are traumatized can trigger vitiligo and we have two known cases in our practice, where laser resurfacing triggered depigmentation consistent with vitiligo, in patients with a first degree relative with vitiligo. Relative contraindications include collagen vascular disease, immunosuppression, unrealistic concerns/expectations, and inability to do the appropriate post-operative care. Our technique is described below.

## Pre-Operative Care

For full face resurfacing, we typically prescribe the following medications to be started on the day of treatment: an antibiotic (usually cephalexin 500 mg bid for 10 days, starting the day of surgery), an antiviral (usually acyclovir 400 mg tid for 10 days if there is no or minimal history of HSV), and an antifungal (usually fluconazole 150 mg as a single dose on the 4th day). If the patient has a strong

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history of HSV, we prescribe valacyclovir 500 mg bid for 14 days starting the day before surgery. For those with frequent yeast infections, we will prescribe three oral doses of fluconazole, starting on the 4th post-operative day and taken once orally every other day.

For anxiety and analgesia, we typically prescribe diazepam (5–10 mg po), hydrocodone, and ketorlac tromethamine (30–60 mg im) to be given 45 minutes prior to the procedure. If just the neck is to be treated, the only medications prescribed are valacyclovir for patients with frequent HSV outbreaks and prescription perioperative pain medications.

Two hours prior to resurfacing, and usually while still at home, the patients wash their entire face and neck or showers with hot water. Immediately thereafter, the patient applies a thick layer EMLA (“like frosting on a cake”) over the entire area to be treated, which is then occluded using a plastic wrap (Fig. 1). In most cases, the first application of EMLA will have been largely absorbed within 60–75 minutes. Forty-five minutes before the procedure, the plastic wrap is removed and a second layer of EMLA is applied and then re-occluded with the plastic wrap.

## LASER TREATMENT

For the Coherent UltraPulse<sup>®</sup> 5000 CO<sub>2</sub> laser, the treatment parameters that we use are as follows: 300 mJ, 60 W. The pattern generator is set to an energy density of 6 for the first pass on the face. We use the square-shaped pattern number 3 with the largest spot size available for the pre-selected energy density setting used. For the newer version of the UltraPulse<sup>®</sup> 5000, the Lumenis (Pleasanton, CA) UltraPulse Encore<sup>®</sup> CO<sub>2</sub> laser, comparable settings are 90 mJ and 45 W. The pattern generator settings are the same. These settings are based on the smaller spot size for



Fig. 1. Pre-operative EMLA applied to the neck and occluded with a plastic wrap.

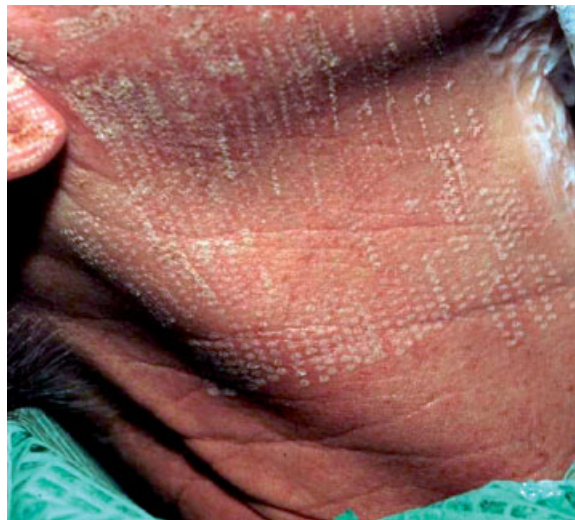


Fig. 2. Area of the neck with EMLA removed and partially treated using CO<sub>2</sub> laser resurfacing. Note whitening in treated areas, however, erythema is minimal immediately after laser exposure.

individual pulses delivered by the computerized pattern generator and overall laser power.

Typically, we treat the full face first and then extend down onto the neck. Immediately prior to treatment, the plastic wrap is removed in quadrants and the skin is then dried with gauze. Each quadrant is fully treated before progressing to the next quadrant using settings appropriate for that individual CO<sub>2</sub> laser. When treating the neck only, we usually treat one half of the neck at a time (Fig. 2).

As we proceed down the neck, the energy density is decreased to a maximum of 3 and often down to the lowest setting of 1. In addition, we also feather laterally using a lower energy density to blend in the treated anterior neck with the untreated posterior neck. This is particularly important for patients with significant sun damage on the lateral and posterior neck. Indeed, for some patients we have done circumferential resurfacing of the entire neck to ensure complete treatment of all the Poikilodermatous changes.

Epidermal debris should never be wiped away after neck resurfacing as this causes additional trauma, which is poorly tolerated by the healing skin in that anatomic location. For this same reason, only a single pass is ever done. Most importantly, we do not treat outside the area of EMLA application, as local hydration is critical for safely treating the neck. When an area outside the region of hydration has been inadvertently treated, healing is notably slower and more pronounced erythema has resulted. These areas have responded to topical steroid and pulsed dye laser treatments.

Post-treatment erythema may take several minutes to appear and may be the only indication as to which areas of skin on the neck have been treated using the aforementioned treatment parameters. For this reason, it is wise to proceed slowly, watching carefully where the individual

exposures have been placed so that successive laser pulses are not overlapped or stacked. We will often go to the next treatment area and then re-examine the previously treated areas after several minutes to ensure that the resultant erythema is even and that no large “skipped” untreated areas between successive laser pulses are produced. If there are “skipped areas,” these can be subsequently treated with a low density of 1–2 using a pattern generator size small enough to fit between the untreated areas.

### Post-Operative Care

Immediately post-resurfacing, a thick layer of petrolatum-based ointment is applied to the entire treated areas using a tongue blade. Commonly, the patient experiences a mild burning sensation for the first 15 minutes post-operatively. However, this usually resolves with ice packs to a tolerable warm sensation. Dilute vinegar soaks (one teaspoon of distilled white vinegar to two cups water) are initiated 2 hours post-operatively and continued every 2 hours during the day. The soaks can be applied over the layer of petrolatum, using gentle pressure with a sopping wet soft cloth (baby washcloths work well). More petrolatum is applied after the soak without drying the skin, to ensure that the treated areas remain as moist as possible.

Initially, the treated neck areas will be pink-red for the first 48 hours. Thereafter, the neck will turn a dark red to purple color similar to that of a scab. This color change is due to the retained epidermal debris that is not wiped off the skin surface during the procedure. The soaks should be gentle so as not to remove this debris until the skin underneath has completely healed, which typically occurs on the fifth to seventh post-operative day. At 7–10 days post-operatively, the treated areas of the neck may still be pink but the skin returns rapidly to normal color within a few weeks, typically healing faster than the face.

If treatment has extended beyond the area of EMLA application and, hence, proper hydration has not been adequately obtained, then the skin will be redder and heal more slowly (Fig. 3). If this occurs, topical steroids and possible pulsed dye laser treatment may be needed to reduce the skin irritation. In such instances, the patient should be cautioned to wear clothing that will not rub or irritate the treated areas for the first month post-operatively. A thick layer of petrolatum is usually sufficient, however, in addition patients can apply a clean plastic wrap to further protect any areas that are healing slowly.

### RESULTS

Improvements can readily be seen in Figures 4 and 5. The primary benefit of CO<sub>2</sub> laser resurfacing of the neck is optimal “blending” of laser-treated skin into adjacent non-treated neck and chest areas. Rhytides can be minimized and textural and pigmentary changes are improved. Overall, patients are satisfied with the improvement in the appearance of their neck skin as long as they are properly educated on the limitations of the procedure prior to surgery.



Fig. 3. One-week post-operative CO<sub>2</sub> laser resurfacing of the neck. Note increased erythema on the lowest portion of the neck where it was likely treated with the lowest density but outside of the area that received pre-operative EMLA hydration.

In our previously published article on CO<sub>2</sub> laser resurfacing [2], we demonstrated the beneficial effects of EMLA skin hydration pre-operatively to protect the epidermis and decrease the procedure’s side effect profile. In that study, neck skin was resurfaced with the CO<sub>2</sub> laser using identical treatment parameters, but only one side received pre-operative EMLA hydration. The contralateral treated side did not receive pre-operative EMLA hydration. Both sides were biopsied immediately after CO<sub>2</sub> laser skin resurfacing. Figure 6 demonstrates the dramatic effect of pre-operative EMLA hydration on the treated epidermis. With pre-operative EMLA hydration, the epidermis is intact although some minor thermal-induced changes including vacuolization of keratinocytes and mild homogenization of the superficial collagen are evident (Fig. 6A). Without pre-operative EMLA hydration, the epidermis is necrotic and partially ablated (Fig. 6B).

### Side Effects

Post-inflammatory hyperpigmentation can be seen, especially in patients with darker skin phototypes. Therefore, it is imperative that patients use a good broad-spectrum sunscreen (i.e., zinc oxide) to block as much

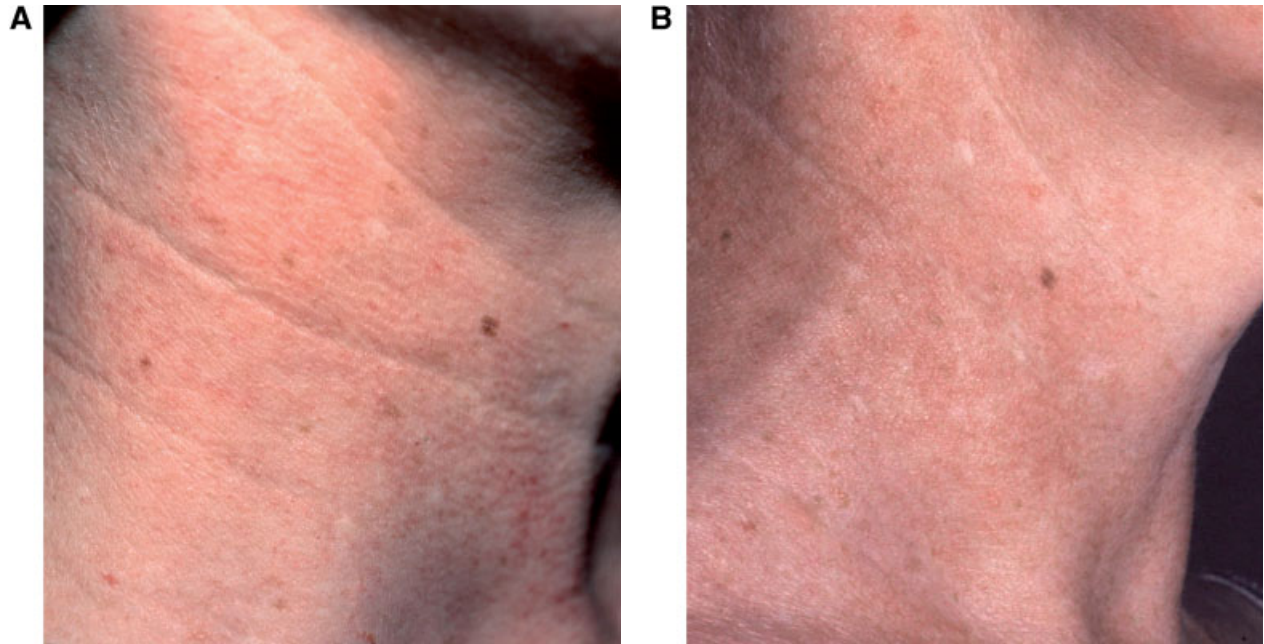


Fig. 4. Pre- (A) and 1-year post-operative (B) CO<sub>2</sub> laser resurfacing of the neck in a 49-year-old woman. Note improvement in deeper rhytides as well as overall texture and pigmentation.

ultraviolet light as possible. Post-inflammatory hyperpigmentation is much less common after neck CO<sub>2</sub> laser skin resurfacing than on the face. It is more common in skin phototypes III–VI. If hyperpigmentation does occur (typically 4–6 weeks post-operatively), it responds well to topical hydroquinone preparations of which there are a

variety available. We have never seen this side effect to be unresponsive to appropriate therapy.

In contrast, hypo- and depigmentation can be permanent but we have observed this side effect in only 2 of a total of 1,851 patients receiving CO<sub>2</sub> laser skin resurfacing on the neck. In both of these cases, small areas of depigmentation

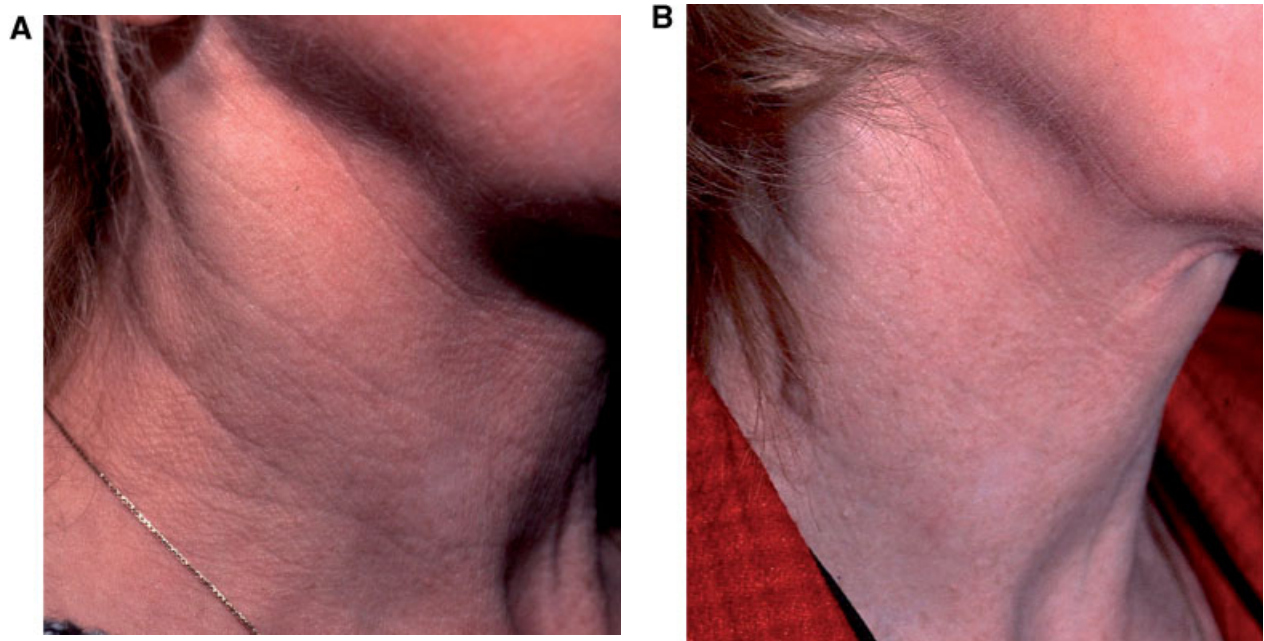


Fig. 5. Pre- (A) and 14 months post-operative (B) CO<sub>2</sub> laser resurfacing of the neck in a 54-year-old woman with previous scar from basal cell carcinoma. Note improvement in overall texture and pigmentation.

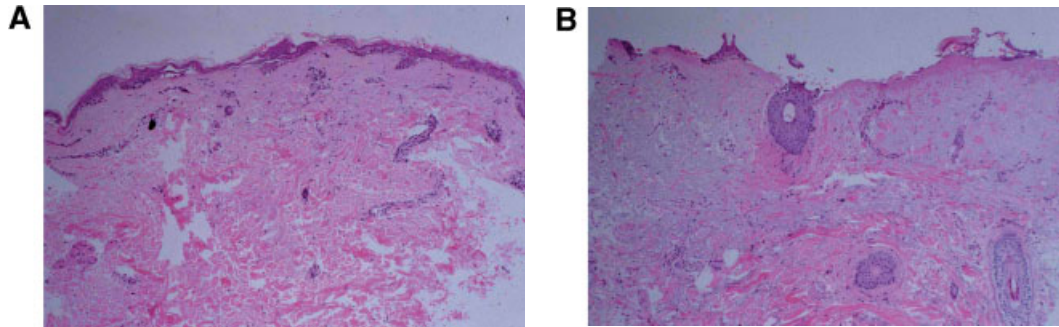


Fig. 6. Hematoxylin and eosin stained and taken at 100× magnification: (A) with pre-operative EMLA hydration, the epidermis is intact although some minor thermal-induced changes are evident; (B) without pre-operative EMLA hydration, the epidermis is necrotic and partially ablated.

persisted for more than 1 year post-operatively and were deemed to be permanent. This incidence of hypo- and depigmentation after CO<sub>2</sub> laser skin resurfacing on the neck is much lower than that reported for facial resurfacing [3] or our own clinical experience of approximately 1%. We have seen vitiligo-induced depigmentation on the face. However, the two cases we described above were directly related to post-operative HSV infection and occurred in patients that had full face as well as neck CO<sub>2</sub> laser skin resurfacing. The HSV infection progressed from the chin down onto the sub-mental region and upper neck. We have not seen any depigmentation in the lower half of the neck, and the only hypopigmentation has been relative to the surrounding chronic sun damage changes, now commonly referred to as actinic bronzing. This contrast can be minimized by feathering or blending the newly treated area into the untreated area by gradually decreasing the treatment energy density.

## CONCLUSION

In conclusion, when performed as outlined above, CO<sub>2</sub> laser resurfacing can be a very safe and effective way to

treat photodamaged human skin and improve the appearance of the neck. It is imperative, however, that the treated skin on the neck receives pre-operative EMLA hydration, laser parameters are set at the appropriate lower energy densities, and the epidermis is not wiped or further traumatized post-operatively. In addition, careful placement of successive laser pulses is needed to ensure that there are no overlapped areas or pulse stacking. Finally, “blending” the treated skin into the immediately adjacent non-treated skin is important when noticeable actinic bronzing and/or other sun-induced changes are present.

## REFERENCES

1. Fitzpatrick RE, Geronemus RG, Grevelink JM, Kilmer SL, McDaniel DH. A multicenter clinical study of UltraPulse CO<sub>2</sub> laser resurfacing. *Lasers Surg Med Suppl* 1996;8:48.
2. Kilmer SL, Chotzen V, Zelickson BD, et al. Full-face laser resurfacing using a supplemented topical anesthesia protocol. *Arch Dermatol.* 2003;139(10):1279–1283.
3. Manuskiatti W, Fitzpatrick RE, Goldman MP. Long-term effectiveness and side effects of carbon dioxide laser resurfacing for photoaged facial skin. *J Am Acad Dermatol* 1999;40: 401–411.