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Journal

Lasers in Surgery and Medicine, 41(3)

ISSN

0196-8092

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Publication Date

2009-03-01

DOI

10.1002/lsm.20755

Published in final edited form as:
Lasers Surg Med. 2009 March ; 41(3): 185–188. doi:10.1002/lsm.20755.

Hypertrophic Scarring of the Neck Following Ablative Fractional Carbon Dioxide Laser Resurfacing

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Abstract

Background—Ablative fractional carbon dioxide (CO_2) laser treatments have gained popularity due to their efficacy, shortened downtime, and decreased potential for scarring in comparison to traditional ablative CO_2 resurfacing. To date, scarring with fractional CO_2 lasers has not been reported.

Objective—Five patients treated with the same fractional CO_2 laser technology for photodamage of the neck were referred to our practices 1–3 months after treatment. Each patient developed scarring. Of the five cases, two are discussed in detail. The first was treated under general anesthesia on the face and anterior neck at a pulse energy of 30 mJ (859 μm depth) with 25% coverage. Eleven days after treatment, three non-healing areas along the horizontal skin folds of the anterior neck were noted. At 2 weeks after CO_2 ablative fractional resurfacing, these areas had become thickened. These raised areas were treated with a non-ablative fractionated 1,550 nm laser to modify the wound healing milieu. One week later, distinct firm pale papules in linear arrays with mild hypopigmentation had developed along involved neck skin folds. Skin biopsy was performed. For the second patient, the neck was treated at a pulse energy of 20 mJ (630 μm depth) with 30% coverage of the exposed skin, with a total treatment energy of 5.0 kJ. Minimal crusting was noted on the neck throughout the initial healing phase of 2 weeks. She then experienced tightness on her neck. Approximately 3 weeks after treatment, she developed multiple vertical and horizontal hypertrophic scars (HS).

Results—Histopathology for the first case confirmed the presence of a hypertrophic scar. The papules in this case completely resolved with mild residual hypopigmentation after treatment with topical corticosteroids. HS failed to resolve in the second case to date after 1 month.

Conclusion—As with traditional ablative CO_2 laser resurfacing, HS is a potential complication of ablative fractional CO_2 laser resurfacing, particularly on the neck. With early diagnosis and appropriate treatment HS of neck skin may be reversible. We urge caution when treating the neck with this device and close attention to wound care in the post-operative period.

Keywords

fractional resurfacing; fractional photothermolysis; ablative fractional resurfacing; CO_2 laser resurfacing; fractional CO_2 resurfacing; laser complications; hypertrophic scar; Fraxel; neck rejuvenation

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INTRODUCTION

Fractional photothermolysis is a method of skin rejuvenation that produces a unique thermal damage pattern characterized by multiple columns of thermal damage, known as microthermal treatment zones (MTZs) surrounded by untreated tissue [1]. The untreated tissue serves a reservoir for rapid healing after treatment.

Originally, fractional photothermolysis using near-infrared light, which left the stratum corneum intact, was confined to non-ablative procedures. Recently, the concept of fractional photothermolysis has been extended to ablative laser wavelengths produced by erbium:YAG (2,940 nm) and carbon dioxide (10,600 nm) lasers [2,3]. Ablative fractional resurfacing (AFR) has been shown to provide safe and effective improvement of facial rhytides, photodamaged skin, and acne scars [4,5]. AFR Er:YAG and CO_2 lasers are the first devices which safely and effectively ablate reticular dermal tissue in resurfacing photodamaged skin [6]. While not as effective as traditional ablative resurfacing, AFR is thought to be a safer procedure due to its unique thermal damage pattern, which spares most of the treated area. In comparison, AFR appears to significantly diminish post-procedure erythema, edema, wound care, downtime, hyper- or hypopigmentation, infection, and scarring. To date, scar formation after treatment by ablative fractional lasers has not been reported. Er:YAG and CO_2 laser AFR are perceived by some as being so safe that their use has been delegated to non-physicians.

In the past few months, several patients have presented to our offices with hypertrophic scars (HS) on the neck after treatment with the same type of ablative fractional CO_2 laser. Due to restrictions imposed by potential litigation, we discuss in detail only two of these five patients. We present photographic images of all five patients. With these case data, we aim to educate and alert our colleagues as to the potential for scarring of the neck with this new approach to skin photorejuvenation.

CASE PRESENTATIONS

Patient #1

A 57-year-old Caucasian woman with Fitzpatrick phototype II skin underwent CO_2 laser AFR (Fraxel re:pair®, Reliant Technologies, Inc., Mountain View, CA) under general anesthesia for treatment of facial acne scars and neck photodamage (rhytides and laxity). The patient had no history of isotretinoin use within 1 year of the procedure. Her anterior neck and chest were treated using a pulse energy of 30 mJ (859 micrometer depth) with treatment coverage of 25% of the exposed skin.

Post-operative care consisted of wet gauze soaks and bland emollients. The post-operative course was unremarkable until day 7 when three horizontal “necklace-like” lines of delayed wound healing were noted on the anterior neck. Wound care then included cleansing and application of bacitracin zinc ointment every 2 hours. On post-operative day 11, the non-healing areas became tender and the patient discontinued the cleansing due to pain. The affected areas now featured small papules and diffuse erythema. Bacitracin application continued. No pustules or vesicles were present at anytime in the post-operative period. No bacterial, fungal or viral cultures were performed.

On post-operative day 15, the area was treated with a non-ablative fractional Er:glass (1,550 nm) resurfacing laser (Fraxel re:store®, Reliant Technologies, Inc., Mountain View, CA) in order to “modify healing” and “flatten thickened areas.” A 10 mJ (555 μm depth), pulse energy was applied for 14% skin coverage.

On post-operative day 20, the patient developed a pruritic eruption on the anterior neck consisting of macular erythema, desquamating scale, and mild induration in horizontal arrays. The rash was also notable for patchy incomplete hypopigmentation. Oral benadryl did not ameliorate the rash or pruritus. At that time, a diagnosis of a resolved cutaneous candidiasis infection with residual inflammation was considered and treated with 0.1% triamcinolone ointment twice daily for 1 week.

Six days later, the eruption had completely resolved. Physical examination was notable for multiple well-defined, firm pale papules in linear arrays along skin folds of the anterior neck (Fig. 1). A clinical diagnosis of prior candidal infection with HS after CO_2 AFR was made. The triamcinolone ointment was discontinued and clobetasol 0.05% cream applied twice daily to the papules was initiated. A punch biopsy specimen was obtained to confirm the diagnosis.

Histopathologic examination showed a hypertrophic scar characterized by epidermal atrophy, follicular plugging, fibroplasia and angioplasia with dense collagen bundles replacing the dermis and extending into the platysma muscle (see Fig. 2 path).

Three weeks later, the papules had completely resolved. Clobetasol cream was discontinued. Mild hypopigmentation has persisted 3 months later.

Patient #2

A 61-year-old Caucasian woman with Fitzpatrick phototype I skin presented for treatment of acne scars on the cheeks and photodamage on the face and neck. Her past medical history was significant for a facelift (1994), traditional full-face ablative CO_2 resurfacing (1996), and minimal access cranial suspension (MACS) face and neck lifts (June, 2008). The patient had successfully undergone multiple treatments with a non-ablative fractional Er:glass (1,550 nm) laser (Fraxel re:store®) on the face, chest and neck over the course of 2 years without any adverse sequelae. There was no history of abnormal wound healing or isotretinoin use within the preceding year.

One day prior to the CO_2 AFR procedure, the patient began a 1 week course of prophylactic oral valacyclovir and levofloxacin. In October 2008, her face and neck were treated with CO_2 AFR. Her neck was treated at a pulse energy of 20 mJ (630 μm depth) with 30% coverage of the exposed skin and a total treatment energy for the neck of 5.0 kJ.

Immediate post-treatment swelling and a pixilated pattern of pinpoint bleeding were noted in all areas treated. Post-operative wound care consisted of vinegar soaks followed by Aquaphor ointment applied every 2–3 hours. On post-operative Day 5, the vinegar soaks were discontinued as re-epithelialization was almost completed, but the Aquaphor ointment was continued for a few more days on focal crusting. Expected epidermal sloughing and crusting were noted mainly on her cheeks. Minimal crusting was noted on the neck throughout the initial healing phase (Fig. 3).

Until 2 weeks after treatment, the patient experienced a normal course of wound healing on her face. She did, however, note “tightness” on her neck beginning at that time. Approximately 3 weeks after treatment, she noted firm linear bands over the treated area diagnosed as multiple vertical and horizontal hypertrophic scars (Fig. 4). Treatment with intralesional kenalog (10 mg/cc) injections and pulsed dye laser treatments have produced improvement, but not resolution, of HS 1 month after CO_2 AFR.

Clinical scarring was observed in three additional patients (Figs. 5-7).

DISCUSSION

To our knowledge, these are the first reports of clinically and histopathologically confirmed HS following fractional CO_2 laser resurfacing. Hypertrophic scarring of both facial and non-facial sites is an unfortunate, well-documented complication of traditional ablative CO_2 laser resurfacing [7,8]. HS can occur in this setting as a consequence of post-operative bacterial, fungal or viral infection, as well as application of excessive thermal energy to the skin. It is noteworthy that HS in each of these cases occurred on the neck and not other treated areas. Non-facial and, in particular, neck skin is more vulnerable to thermal injury by virtue of underprivileged wound healing capabilities as compared to the face. The most commonly cited explanation for this phenomenon rests with fewer pilosebaceous units on the neck providing less efficient epibolic wound re-epithelialization and more limited cutaneous vasculature providing less support for wound healing.

It is as yet unclear whether AFR with Er:YAG or CO_2 laser energy would be more or less likely to lead to HS of the neck. If scarring occurs based upon the thermal injury profile alone, then, controlling for the fraction of skin treated, one would expect greater safety using fractional Er:YAG laser resurfacing. Moreover, the broader thermal injury zone surrounding fractionated CO_2 laser MTZs may be more likely to cause excessive volumetric tissue injury which goes unrecognized by the treating physician. Certainly, use of either ablative fractional laser on the neck should be performed at the least pulse energy, pulse density, and treatment fraction necessary to avoid complications and yet produce satisfactory improvement. The presented cases do assist the practitioner in defining treatment parameters which have proven excessive in these patients. The pattern of linear scarring present in these patients also suggests the possibility of excessive thermal injury incurred through excessive overlap of CO_2 energy application.

The risk of HS of the neck may relate more to ablation of the epidermis providing in exuded blood and serum an excellent culture medium for potentially pathogenic skin flora to grow and gain entry into the skin. This fact demonstrates the need, as with traditional ablative resurfacing, for close observation during the early post-operative period by knowledgeable physicians to diagnose and treat infections. Indeed, infection may have played a role in Patient #2, where a clinical diagnosis of a resolved candida infection was suspected.

Finally, face and neck lifting procedures produce a subtle fibrosis which interrupts the continuity of the normal cutaneous vasculature, further limiting wound healing capacity and imperiling outcome of photothermal treatments, as well as placing underprivileged neck skin on facial sites. Treating physicians should elicit any history of plastic surgical procedures, which may have mobilized neck skin into a position above the jawline.

Our goal is to avoid future complications of HS through dissemination of these cases. Based upon the presented evidence of HS following CO_2 laser AFR, we urge particular caution when treating the neck with any ablative fractional laser. We offer no definitive explanation for the scarring in any of these cases, although excessive laser energy application, post-operative wound infection, and prior lifting procedures are implicated. The authors do not believe that ablative fractional CO_2 laser procedures should be performed by anyone other than an appropriately trained physician who is experienced in post-operative wound care following laser resurfacing.

CONCLUSION

HS is a significant and potentially permanent complication of ablative fractionated CO_2 laser resurfacing, particularly on the neck. We urge caution when treating this area.

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Fig. 1.
Three weeks post-treatment with CO_2 AFR followed by Er:glass non-ablative fractional resurfacing: multiple well-defined, firm pale papules in linear arrays along skin folds of the anterior neck consistent with HS are apparent on the neck of a 57-year-old woman (Patient 1).

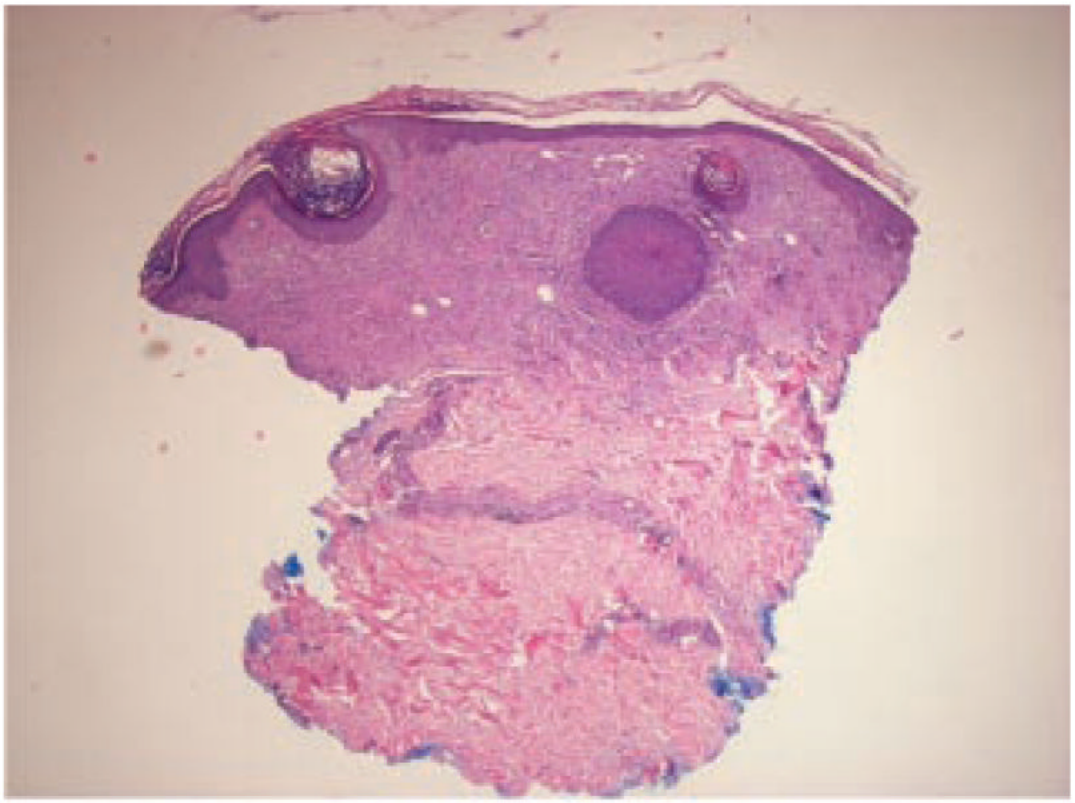

Fig. 2.
Photomicrograph of a biopsy specimen from the right anterior neck of Patient 1 shows a hypertrophic scar characterized by epidermal atrophy, follicular plugging, fibroplasia, and angioplasia with dense collagen bundles replacing the dermis and extending into the platysma muscle (H&E, 4×magnification).

Fig. 3.
Erythema and crusting is apparent on the neck of Patient 2 during the initial healing phase after CO_2 AFR.

Fig. 4.
Approximately 3 weeks after treatment, the neck of Patient 2 displays firm linear bands over the treated area consistent with multiple vertical and horizontal hypertrophic scars.

Fig. 5.

A middle-aged woman, with a 2-year history of vertical hyperpigmented striations and scars on her neck following CO_2 AFR. This patient had presented 2 years earlier for treatment with a then investigational ablative fractionated CO_2 laser. Her face was treated using a pulse energy of 15 mJ, pulse density of 400 MTZ/cm^2, and four passes. Her neck was treated at the same pulse energy and density in two passes. Her post-operative course was notable for areas of bruising and swelling, especially periorbitally. Post-operative care consisted of frequent application of cold compresses and emollient. Two weeks after treatment vertical, pigmented lines appeared on her anterior neck. At 4 weeks, the vertical striations had not faded. A 6-week course of topical Triluma failed to produce any improvement.

Fig. 6.

A 55-year-old woman with Fitzpatrick phototype II skin 4 weeks after treatment with CO_2 AFR of the face and neck. Horizontal and vertical hypertrophic scars are noted on the anterior neck. There were no other areas of HS. Treatment settings for this patient are not available.

Fig. 7.

A middle-aged woman as she appeared 4 weeks after treatment with CO_2 AFR of the face and neck. Vertical HS is noted on the anterior neck. There were no other areas of HS. Treatment settings for this patient are not available.