Fractional Photothermolysis for the Treatment of Postinflammatory Hyperpigmentation after Carbon Dioxide Laser Resurfacing

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A common complication of carbon dioxide (CO₂) laser resurfacing is postinflammatory hyperpigmentation, which can occur in up to 20% to 30% of all patients.¹⁻⁴ Although most cases respond to topical therapy with retinoids, steroids, hydroquinone, topical vitamin C, or some combination, 5% to 10% of all patients treated with CO₂ laser resurfacing can develop chronic, lifelong, treatment-resistant dyschromia.⁵ In this report, we describe a case of CO₂ laser–induced pigmentation refractory to topical bleaching agents treated with fractional photothermolysis. This is a gentle approach to laser resurfacing, whereby the skin is resurfaced fractionally (15–30%) each treatment session.⁶,⁷ This is accomplished using a 1,550-nm wavelength laser to place microscopic zones of thermal damage in the epidermis and dermis surrounded by islands of normal tissue. The normal skin left untreated serves as a reservoir for healing, allowing the skin to heal rapidly. This procedure is typically repeated for four to six sessions every 2 to 4 weeks. In this way, one can resurface a large portion of the skin over time. To our knowledge, this is the first report of CO₂ laser–induced dyschromia treated with this modality.

Case Report

A 42-year-old woman with Fitzpatrick skin type II who had previously undergone two-pass CO₂ laser resurfacing for photorejuvenation presented to our outpatient cosmetic dermatology clinic. One and one-half years after the procedure, she developed delayed dyschromia characterized by reticulate hyperpigmentation (Figure 1). Wood’s light examination suggested the presence of pigment in the epidermis and dermis. Over the course of 1 year, she received 4% hydroquinone, tretinoin, midpotency topical steroids, and a series of 35% to 70% glycolic acid peels. In addition, she underwent six intense pulsed-light treatments and six sessions of 20-μm Sciton peels (Sciton Inc., Palo Alto, CA), all with minimal response. Outside dermatologists performed treatments, and complete parameters for each treatment were not available. The patient also denied taking any systemic medications (e.g., oral contraceptives) or over-the-counter topical agents that could aggravate dyschromia.

After initial evaluation in our clinic in the southwestern United States, we recommended fractional photothermolysis for her dyschromia. Before treatment, an explanation of the risks, benefits, and potential complications of the procedure was given, and written informed consent was obtained. Anesthesia was achieved with a topical 30% lidocaine gel for 1 hour before each treatment. A blue dye (FD&C No. 1), which serves as a guide marker for the intelligent optical tracking device of the laser handpiece, was used to demarcate the areas of laser treatment. The patient was treated with fractional

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photothermolysis for five sessions spaced 1 to 2 weeks apart. For each session, a 1,550-nm wavelength Fraxel 750 SR laser (Reliant Technologies Inc., Mountain View, CA) was used at a pulse energy of 6 to 10 mJ and a final density of 2,000 to 3,000 microscopic thermal zones/cm\(^2\). We chose these settings based on a previous study in which they were used successfully to treat epidermal and dermal pigmentation associated with melasma. During each treatment, an air cooling device was used to aid in pain management and to minimize the possibility of bulk heating.

The patient tolerated each procedure well without complication. She was instructed to apply Aquaphor ointment immediately post-treatment, followed by a few days of a bland moisturizer. She was also instructed to avoid the use of bleaching agents during the course of treatment and to wear a broad-spectrum sunscreen. After five sessions over a 2-month period during the fall, she showed at least 50% to 75% improvement in her dyschromia from baseline that was maintained 3 months after the last session (Figure 1).

Discussion

The use of the CO\(_2\) laser for rejuvenation of photodamaged skin of the face has been well described, but up to one-third of all CO\(_2\) laser–treated patients develop postinflammatory pigmentation within 1 to 2 months after the procedure. This incidence triples in patients with darker skin types (Fitzpatrick types IV through VI).\(^3,4,9\) Although multiple studies have shown that preoperative use of topical bleaching agents such as tretinoin, steroids, hydroquinone, vitamin C, and glycolic acid does not reduce the incidence of post-treatment hyperpigmentation, some studies have suggested that early postoperative treatment with such agents can reduce the incidence of post-treatment hyperpigmentation by 75%.\(^5,10\)

Fortunately, in most cases, CO\(_2\) laser resurfacing hyperpigmentation is a transient phenomenon that resolves within 4 months after laser therapy, whether or not postoperative therapy is instituted,\(^5\) but up to 5% to 10% of CO\(_2\) laser–treated patients develop a chronic refractory dyschromia, despite aggressive topical therapy with chemical bleaches or epidermal peels. Treatment options in this population are practically nonexistent. Here we describe a patient with CO\(_2\) laser–induced hyperpigmentation refractory to topical treatment who improved significantly after five sessions of fractional photothermolysis. The 1,550-nm wavelength used in fractional photothermolysis allows penetration of approximately 1,000 \(\mu\)m into the skin, which makes fractional photothermolysis of deeply located melanin possible and provides a significant advantage over topical bleaching agents as well other nonablative lasers that cannot penetrate to this depth.\(^11\) Furthermore, fractional photothermolysis has been shown to be safer from the standpoint of postprocedure scarring and hypo- or depigmentation than other laser resurfacing modalities in darker skin types, the group at highest risk for complications.
risk for postinflammatory hyperpigmentation after CO\(_2\) laser treatment.

We speculate that the removal of pigment in this patient was due to the extrusion of microscopic epidermal necrotic debris (MEND). MEND are the vertical columns of thermal injury in the epidermis and dermis created by fractional resurfacing that are extruded 3 to 5 days after the procedure. Previous histologic studies of MEND have revealed their high melanin content, a fact that may account for the local improvement in skin pigmentation after fractional resurfacing.\(^{12}\)

Although the patient treated in our study tolerated the procedure well, without any infectious or cosmetic complications, additional controlled, split-face studies with larger sample sizes, multiple skin types, and longer-term follow-up are necessary to further evaluate the efficacy and safety of fractional photothermolysis for treatment of CO\(_2\)-induced postinflammatory hyperpigmentation and to optimize parameters. In particular, further studies in subjects with darker skin types are needed, because darker skin phototypes may not respond as well to fractional resurfacing because of the risk of postinflammatory pigmentation from fractional resurfacing itself.\(^{8}\)

References


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