Bimatoprost drug delivery with fractional laser and microneedling for the management of COVID-19 prone positioning–induced facial atrophy and hypopigmentation

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INTRODUCTION

Prone positioning, a postural adjuvant therapy for improving ventilation, has been widely used to treat COVID-19 pneumonia complicated by acute respiratory distress syndrome that can reduce mortality when used for at least 12 hours a day.[1] The extensive time needed for prone positioning to be effective may result in prolonged pressure points on the face leading to facial ulcers. Before the COVID-19 pandemic, facial pressure ulcers due to prone positioning in the setting of acute respiratory distress syndrome had already been described.[1] These facial ulcers frequently occur at the level of the bony structures, including the forehead, cheekbone, and chin.[1] It has been hypothesized that in the context of severe COVID-19 pneumonia, hypoxemia, microvascular injury, and thrombosis may increase the risk of pressure ulcers.[1] Once healed, these wounds can have a lasting impact on the patient as they may lead to scarring, dyspigmentation, and atrophy.

Patients find hypopigmented scars to be more bothersome than hyperpigmented scars.[2] These scars are particularly stigmatizing distressing when in the cervicofacial region and in patients of color who represent more than 60% of the world's population.[2-4] Hypopigmented scars are difficult for dermatologists to treat because there are limited effective and practical treatment options available that yield long-lasting results. Treatment options implicated in the management of hypopigmented scars include cosmetic camouflage, microneedling, dermabrasion, chemical peels, skin excision, and laser therapy.

Herein, we report our success in achieving repigmentation in the setting of atrophic, depigmented, and hypopigmented scars using CO_2 laser drug delivery of bimatoprost and microneedling.

CASE REPORT

A 58-year-old African American woman, with skin phototype V, who was undergoing adjuvant therapy for invasive ductal carcinoma of the right breast, presented to the emergency department with worsening oral pain, odynophagia, and anorexia and was found to have a febrile neutropenia and COVID-19. Her hospital course was complicated by acute respiratory distress syndrome, necessitating the admission to the intensive care unit, treatment with hydroxychloroquine, and endotracheal intubation with prone positioning cycles. The patient spent 16 to 20 hours in prone positioning for a total of 6 days, developing stage 2 facial pressure ulcers on day 5 of pronation. Four months later, the patient presented to the dermatology department with facial atrophic scarring, depigmentation, and hypopigmentation

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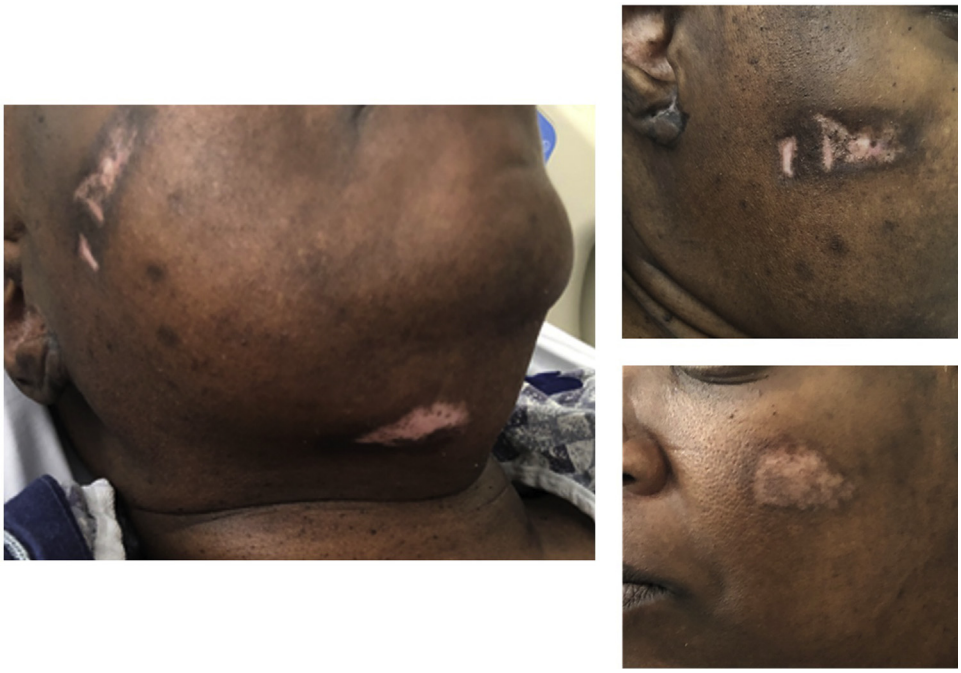

Fig 1. COVID-19 prone positioning–induced atrophy and hypopigmentation of bilateral cheeks and submandibular area.

resulting from wounds that developed during prone positioning.

On presentation, the patient had asymmetric hyperpigmented patches surrounding an atrophic depigmented and hypopigmented center on her bilateral cheekbones and submandibular area (Fig 1). During the initial evaluation, 8 passes of microneedling in each direction with the dermaroller were completed. She was also prescribed bimatoprost solution to apply to the hypopigmented areas twice daily and hydroquinone 4% spot treatment for the hyperpigmented patches. After 2 additional sessions of microneedling and 2 to 3 mL of 0.03% bimatoprost solution, spaced at 4-week intervals, the patient began fractional 10,600-nm CO_2 laser therapy (Lumenis). DeepFX mode was used; settings consisted of a single pass with a fluence of 10 mJ, a square shape with a spot size of 7 mm, and a density of 5 corresponding to 13% coverage. Approximately 2 to 3 mL of 0.03% bimatoprost solution was applied using fractional drug delivery after laser-ablated channels were created. Bimatoprost was occluded with petroleum jelly and a bandage. She continued applying the prescribed bimatoprost solution to the hypopigmented areas twice daily and hydroquinone 4% spot treatment to the hyperpigmented patches.

The patient reported significant improvements in the atrophic and hypopigmented scars following 3 laser sessions spaced at 6-week intervals (Fig 2). She had repigmentation of these hypopigmented and depigmented scars, as well as improved texture and atrophy (Fig 2). During her most recent follow-up appointment 10 months from the initial presentation, she had sustained improvement in the presentation of her scars. There were no adverse events noted, and although bimatoprost induces hyperpigmentation, there was no worsening of the hyperpigmented lesions. Although restoration of baseline color was not achieved, it is anticipated after the improvement of the hyperpigmented areas. Due to the expedited onset of improvements seen in this case, we successfully performed this technique of transepidermal bimatoprost delivery on a second patient with hypopigmented scars due to surgery and chemoradiation.

DISCUSSION

This report demonstrated a novel approach combining fractional resurfacing with transepidermal delivery of bimatoprost in a patient with Fitzpatrick phototype V who was experiencing atrophic, depigmented, hypopigmented scarring secondary to prone positioning in the setting of COVID-19 endotracheal intubation. Hypopigmented and depigmented scars such as the ones seen in this patient present a therapeutic challenge for dermatologists.

Prior studies support the use of topical bimatoprost following microneedling and/or ablative

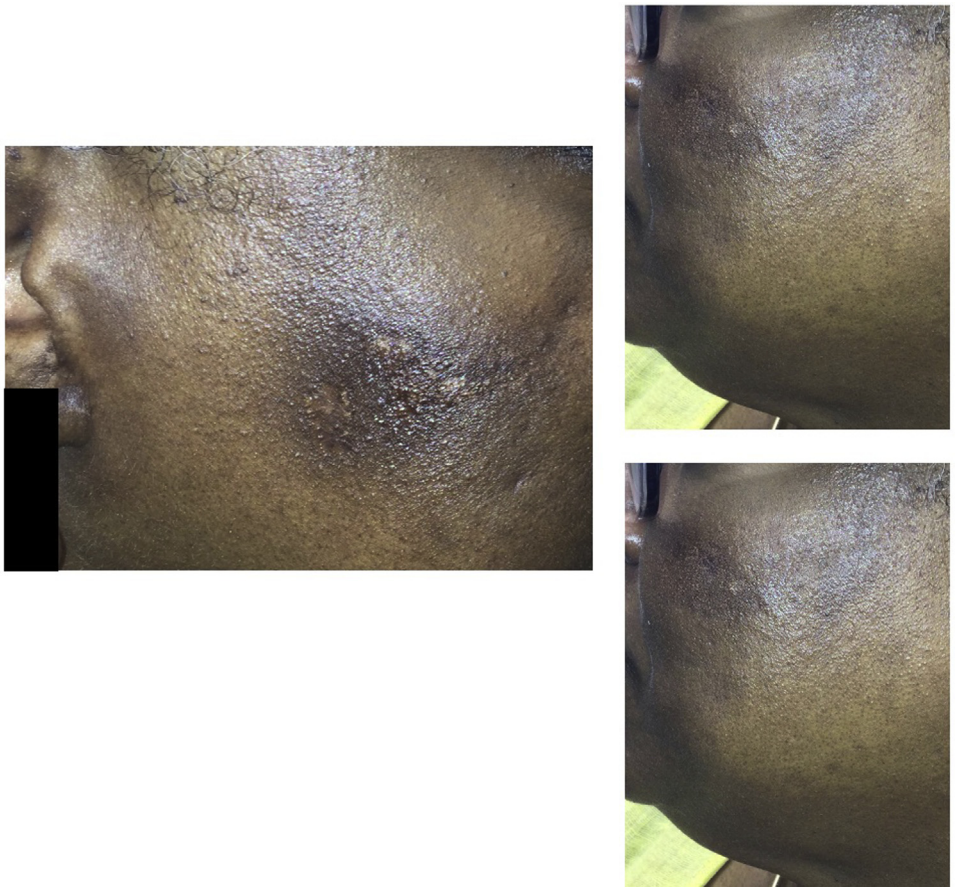

Fig 2. Marked improvement of COVID-19 prone positioning–induced atrophy and hypopigmentation of the cheek after a combined regimen of microneedling/laser assisted drug delivery of topical bimatoprost solution.

fractional laser for improving the appearance of hypopigmented scars.[5] A study by Massaki et al[5] found that a mean of 4.5 fractionated 1550-nm erbium-doped laser sessions at 4- to 8-week intervals with subsequent topical bimatoprost helped improve hypopigmented scars. Patients in this study with scars on the face and neck underwent 10 and 4 sessions, respectively, of laser therapy followed by bimatoprost in order to experience 50% to 75% improvement of their scars.[5] We were able to achieve this grade of response following only 1 session when a CO_2 laser was used to transepidermally deliver bimatoprost.

Bimatoprost, a synthetic prostaglandin F2α analog, is believed to induce hyperpigmentation by increasing melanocyte dendricity[6] and stimulating tyrosinase, a rate-limiting enzyme in melanogenesis.[7] Transepidermal drug delivery utilizes the permeability alterations induced by ablative resurfacing to increase the delivery of different substances into the skin.[8] Similar approaches of laser-assisted transepidermal drug delivery have been published in the setting of triamcinolone acetonide (Kenalog) delivery for necrobiosis lipoidica, triamcinolone delivery for alopecia areata, and 5-fluorouracil delivery for hypertrophic scars.[8-10] This approach to repigmentation may be useful in patients of color who are prone to developing more visible hypopigmented and depigmented scars due to their increased melanin.

The findings of this case report are limited by the small sample size, lack of a control group, and the anecdotal nature of case reports. Nonetheless, these findings offer a new insight into achieving repigmentation of atrophic depigmented and hypopigmented scars. This case also highlights the importance of interdisciplinary approaches in the management of COVID-19 and its sequelae. Clinicians should be aware of the risk of atrophic hypopigmented scars developing from facial pressure ulcers as a result of prone positioning so as to discuss a therapeutic approach.

Conflicts of interest

Dr Rossi is a consultant for Almirall, Merz, Dynamed, Canfield Scientific, Evolus, Biofrontera, QuantiaMD, Lam Therapeutics, Regeneron, and Cutera; Mavig: travel; is an advisory board member for Allergan Inc; is an advisor for Skinfix; L'oreal, travel, Dr Anthony Rossi companies; has received a Ward Memorial Research Grant from the American Society for Laser Medicine and Surgery, a research grant from Skin Cancer Foundation, research/study funding from Regen, research/study funding from LeoPharma, and research/study funding from Biofrontera; is an editorial board member for Lasers in Surgery and Medicine and Cutis Journal; is an assistant editor for Journal of the American Academy of Dermatology; is a board member for American Society for Dermatologic Surgery; and is a committee member and/or chair for American Academy of Dermatology, American Society for Dermatologic Surgery, and American Society for Laser Medicine and Surgery. Author Wilson and Drs Aleisa and Menzer have no conflicts of interest to declare.

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