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BRIEF COMMUNICATION

Single treatment scar resurfacing with a novel ablative fractional 2910 nm erbium-doped fluoride glass fiber laser

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ablative fractional laser; acne scar; burn scar; fiber laser; laser resurfacing; scar; surgical scar; traumatic scar

INTRODUCTION

Scars are a common dermatologic complaint that can adversely affect an individual's quality of life. With diverse etiologies and types of scars, treatment is often challenging. Myriad treatment options exist ranging from topical medications to surgical revision, however, no scar treatment has been as revolutionary as lasers. Since its introduction, ablative laser resurfacing technology has continually evolved including the development of fractional devices, new wavelengths, and expanding indications. Fractional and conventional ablative lasers cause direct destruction and debulking of scar tissue via vaporization. This tissue vaporization activates heat shock proteins, stimulates antifibrotic factors, and induces dermal matrix remodeling resulting in the reduction of scar tissue and improvement in skin texture.[1] While ablative fractional lasers (AFLs) offer less discomfort and reduced downtime compared to conventional ablative lasers, depending on the scar size and anatomic location, they often still require sedation, regional nerve blocks, or intralesional injections of anesthetic solution. Moreover, they have limited utility in skin of color due to the degree of thermal damage. Thus there remains a need for an AFL that is less painful, safe in skin of color, and effectively resurfaces skin without a prolonged recovery.

This novel 2910 nm erbium-doped fluoride glass fiber laser (2910 nm fiber laser) (UltraClear; Acclaro Medical) targets water at its peak absorption between 2900 and 3100 nm. This highly selective wavelength and the novel pulse delivery system creates ablative microscopic thermal treatment zones while minimizing patient discomfort, recovery time, and residual thermal damage to surrounding tissue.[2] This case series investigates the novel 2910 nm fiber laser for scars of various etiologies in Fitzpatrick skin types I–IV.

MATERIALS AND METHODS

A retrospective case series was conducted with patients who underwent treatment for scars with the 2910 nm fiber laser at a single center in Houston, Texas between the years 2022–2023. Patients presenting for keloids or who had a history of keloids were excluded. A compounded topical anesthetic cream (20% benzocaine, 6% lidocaine, 6% tetracaine) was applied to the affected area for 30 min. The affected area was cleansed with 70% isopropyl alcohol or chlorhexidine gluconate 4% solution before treatment. Patients received a single treatment. A single patient underwent laser-assisted drug delivery with topical application of triamcinolone acetonide 40 mg/mL and 5-fluorouracil at a ratio of 1:9 to the treated surface. Photographs were taken at baseline and 1–3 months

following treatment. Two independent nontreating physicians evaluated the degree of improvement between pretreatment and posttreatment photographs using a 5-point Global Aesthetic Improvement Scale (GAIS) as follows: (0) no improvement, (1) minor improvement, (2) moderate improvement, (3) marked improvement, (4) very significant improvement.

RESULTS

A total of 15 patients with scars were included. Eight patients were female and seven were male. Ages ranged from 13 to 59 years with an average age of 33 years. Fitzpatrick skin types II–IV were represented. Scar types included atrophic ($n = 7$) and hypertrophic ($n = 8$). The etiologies included acne scars ($n = 4$), surgical scars ($n = 3$), burn scars ($n = 3$), traumatic scars ($n = 3$) and cutting scars ($n = 2$). Scar ages ranged from 3 months to 18 years. Patients were treated with the deep laser mode or a combination of superficial and deep laser modes. Depth and coverage for the deep mode ranged from 300 to 750 um and 1.0%–2.5%, respectively per individual pass. Superficial depth and coverage ranged from 10 to 50 µm and 25%–40%, respectively per individual pass. Coagulation used ranged from 9.6–32.0%. Anywhere from one to three passes were performed. Evaluation of digital images by two independent nontreating physicians revealed an average GAIS score of 1.7 for all scars. Atrophic scars had slightly more improvement than hypertrophic scars with an average GAIS score of 2.0 and 1.43, respectively. When considering scar etiology, traumatic scars had the most improvement (3.16), followed by acne scars (1.85), cutting scars (1.75), and burn scars (1.33) (Figures 1–3). Surgical scars had the least improvement with an average GAIS of 0.33. Side

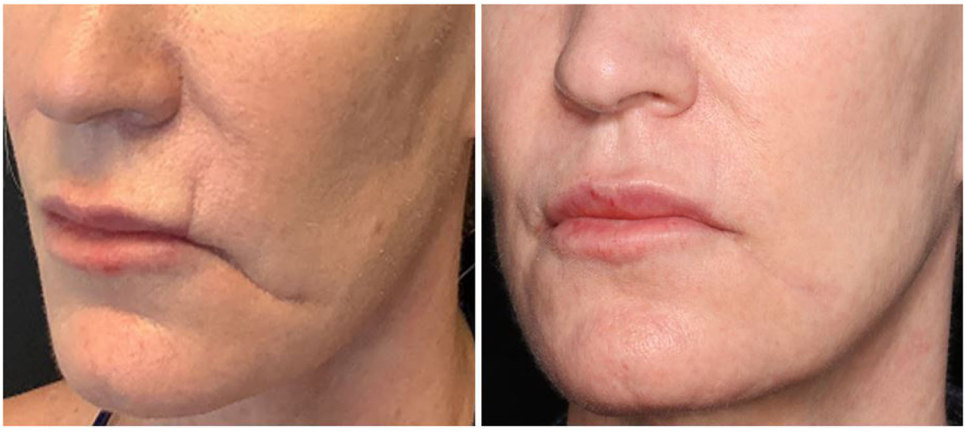

FIGURE 1 A 59-year-old female at baseline (left) and 7-weeks posttreatment with the 2910 nm fiber laser (right).

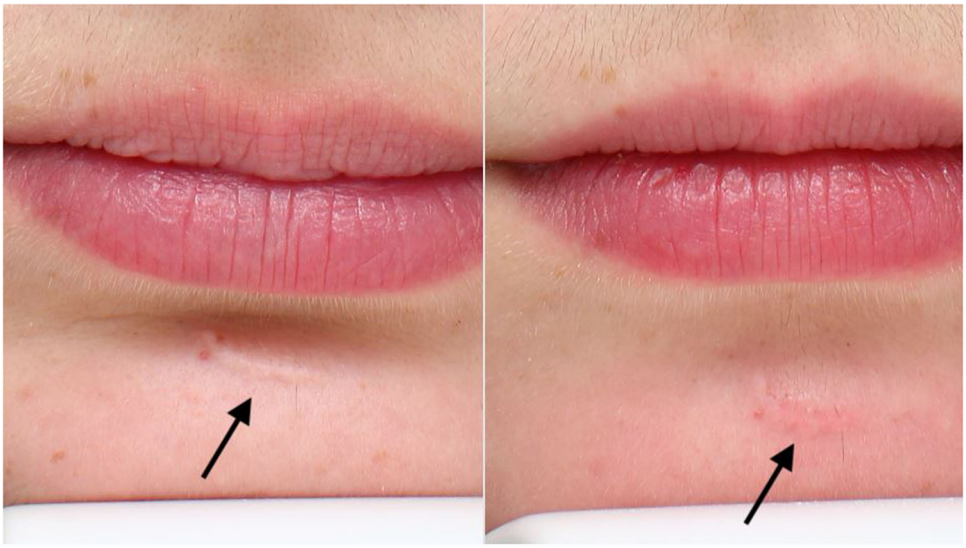

FIGURE 2 A 13-year-old female at baseline (left) and 10-weeks posttreatment with the 2910 nm fiber laser followed by topical application of triamcinolone acetonide 40 mg/mL and 5-fluorouracil at a ratio of 1:9 to the treated surface (right).

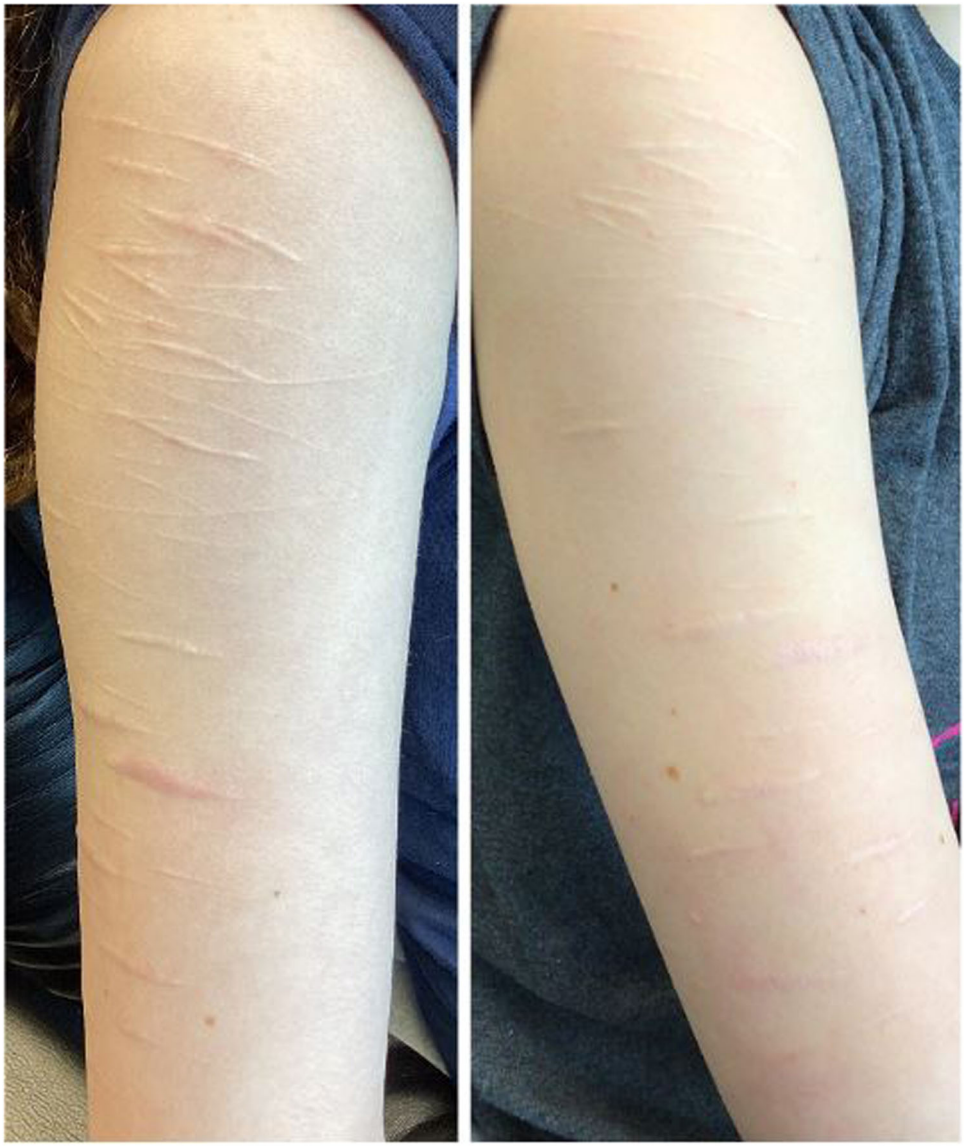

FIGURE 3 A 14-year-old female at baseline (left) and 8-weeks posttreatment with the 2910 nm fiber laser (right).

effects seen were transient and included mild to moderate erythema and edema and occasional pin-point hemorrhage and crusting. There were two instances of transient post-inflammatory erythema. There were no instances of postinflammatory hyperpigmentation, postinflammatory hypopigmentation or scar activation.

DISCUSSION

This case series investigated the clinical effects of a new novel 2910 nm fiber laser for scar resurfacing. The fiber delivery system is highly customizable and ablates tissue via fractionated microbeams from as superficially as 5 μm within the stratum corneum to a depth of up to 1500 μm within the dermis. The novel pulse technology creates ablative microscopic thermal treatment zones while minimizing discomfort and residual thermal damage to surrounding tissue resulting in potentially fewer side effects, shorter downtime and safe treatment in skin of color. This laser has previously been reported to improve mild photoaging in its low-fluence superficial mode.[2] This is the first report to detail the safe and effective treatment of scars.

In this retrospective case study, we observed marked improvement in traumatic scars, consistent with previously reported algorithms supporting AFLs as the gold standard for traumatic scars.[3] Mild to moderate improvement was observed with acne scars, burn scars, and cutting scars and minimal improvement in surgical scars. These results were achieved with a single treatment session, whereas conventional AFLs often require 2–4 treatment sessions for satisfactory improvement of scarring depending on scar type and location.[4] Overall,

treatment yielded high patient satisfaction. One subject with burn scars reported improvement in contracture and range of motion and in another subject with burn scars improvement in hypopigmentation was observed. Of note, one traumatic scar was also treated with laser-assisted drug delivery of triamcinolone acetonide 40 mg/mL and 5-fluorouracil in a ratio of 1:9, likely contributing to the high GAIS score observed for this category.

In addition to its efficacy for various types of scars, the utility of this device lies in its minimal discomfort, reduced downtime, and improved safety profile as a result of the high specificity for water and novel pulse technology.[2] With thermal relaxation time between pulses, pressure and steam have time to escape the microchannel resulting in decreased residual thermal damage to surrounding tissue, faster healing and improved patient tolerability. The reduced discomfort offers significant advantages including utilization of only topical anesthetic cream, comfortable treatment of large surface areas and treatment in the pediatric population where discomfort is often a barrier to early laser intervention. Treating large surface areas with minimal discomfort also facilitates laser-assisted drug delivery, sparing patients from numerous intralesional injections. In our study, the laser treatments were well-tolerated by all patients with the use of topical anesthetic cream. In contrast to other AFLs such as CO_2 and erbium-doped yttrium-aluminum-garnet lasers, patients reported little to no discomfort during the treatment. The downtime was minimal, with most patients reporting a healing time between 4 and 7 days.

Prior histological studies utilizing the superficial mode demonstrated precise destruction to the desired depth without collateral damage to surrounding tissue. Additionally, this superficial laser treatment was shown to induce an inflammatory response within the dermis, likely contributing to tissue remodeling.[2] Our study utilized the deep laser mode alone or a combination of superficial and deep modes, allowing for both epidermal and dermal scar resurfacing. Due to the laser's unique fiber system, energy can be delivered superficially (5–100 μm), deeply (300–1500 μm), or both superficially and deeply within the same pulse. Treatment density for superficial modes (12.5%–75%), deep mode (0.5%–5%), and degree of coagulation are also customizable. This customizability, in conjunction with precisely targeted tissue destruction and minimal collateral thermal damage, make this 2910 nm Fiber Laser equipped to safely and effectively treat scars in skin of color.

Postlaser skin effects were transient and included erythema, edema, and occasional pin-point hemorrhage and crusting. There were no instances of post-inflammatory hyperpigmentation, postinflammatory hypopigmentation, or scar activation, some of the most commonly reported adverse events seen with conventional AFLs.[5]

CONCLUSIONS

Our results demonstrate that treatment with a new novel 2910 nm erbium-doped fluoride glass fiber laser is safe and effective in treating scars of various etiologies and types in Fitzpatrick skin types I–IV. There is reduced patient discomfort, downtime, and side effect profile when compared to other ablative fractional devices. Further studies, including the role of multiple treatment sessions, treatment in FST V–VI, and laser-assisted drug delivery are needed to further characterize this laser's capabilities for improving scars and are currently ongoing at our center.

ACKNOWLEDGMENTS

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CONFLICT OF INTEREST STATEMENT

Acclaro Medical provided the clinical site with this laser device for an unrelated clinical trial. Paul M. Friedman, MD is on the medical advisory board for Acclaro Medical.

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