



Laser-assisted drug delivery in the treatment of keloids: A case of extensive refractory keloids successfully treated with fractional carbon dioxide laser followed by topical application and intralesional injection of steroid suspension

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INTRODUCTION

Keloids are benign fibroproliferative growths that occur from an abnormal response to skin injury and can be disfiguring, functionally impairing, and have dramatic impacts on quality of life. Furthermore, treatment is notoriously challenging, and the rate of recurrence is high. Various treatment modalities have been proposed for keloids including occlusive dressings, compression therapy, silicone sheeting, intralesional corticosteroid injections, cryotherapy, surgical removal, pulsed dye laser, radiation, imiquimod cream, intralesional verapamil, 5-fluorouracil, bleomycin, and interferon- α 2b injections.^{1,2} Laser-assisted drug delivery is an evolving new treatment modality with many possible applications, including keloids and hypertrophic scars.

Here we present a case of refractory keloids treated with laser-assisted drug delivery using fractional ablative laser followed by a combined treatment of topical application and intralesional injection of steroid suspension.

CASE REPORT

A 72-year-old African-American man with Fitzpatrick skin phototype VI presented with a 30-year history of extensive refractory progressive keloid formation involving the anterior and lateral

neck, upper chest, and back (Fig 1, A and C). His medical history was significant for hidradenitis suppurativa, type II diabetes mellitus, hypertension, and chronic obstructive pulmonary disease. The patient's keloidal involvement was exacerbated by his underlying hidradenitis suppurativa, which resulted in draining keloids of the neck and chest. He had a family history of keloids in his mother and brother.

The patient's keloids were painful, cosmetically bothersome, and limiting his range of motion, most notably of the neck. He did not respond to multiple intralesional injections of triamcinolone acetonide suspension, pulsed dye laser, and cryotherapy. Given that keloids on the neck and back were the most symptomatic, we performed laser-assisted drug delivery using fractionated carbon dioxide (CO₂) laser with Deep Fx setting (Ultrapulse Encore; Lumenis Ltd, Santa Clara, CA). Pretreatment consisted of topical 4% lidocaine cream for 30 minutes under occlusion followed by lidocaine injection. The energy settings of the CO₂ laser varied from 15 to 20 mJ on the neck and 20 to 30 mJ on the back. Density was held constant at 5%. Immediately after the laser treatment, 1 mL of 10 mg/mL and 1 mL of 20 mg/mL of triamcinolone acetonide suspensions were drizzled over the keloids and gently rubbed

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Fig 1. **A**, Clinical photograph of keloid on the right shoulder at presentation. **B**, Same keloid after 3 treatments with fractional CO₂ laser treatment followed by topical application and intralesional injections of triamcinolone acetate (20 mg/mL). **C**, Clinical photograph of keloid on the neck at presentation. **D**, Same keloid after 1 treatment with fractional CO₂ laser treatment followed by topical application and intralesional injections of triamcinolone acetate (20 mg/mL).

onto the neck and back, respectively. We then injected 1.5 mL of 10 mg/mL and 2 mL of 20 mg/mL of triamcinolone acetate suspension to the keloids on the neck and back. After the procedure, 2% mupirocin ointment was applied. The patient tolerated the procedure well with only mild discomfort and, in follow-up, he denied any postprocedural swelling, bruising, pain, or purulent discharge.

Interestingly, the patient noticed flattening of keloids and improvement in pain and range of motion after 1 treatment. We performed 3 treatments on the bilateral upper back, which resulted in near-

complete flattening of keloid (Fig 1, B). The Vancouver scar scale of the lesion on the upper back was decreased from 7 at baseline to 2 after treatments. After 2 treatments on the neck, the patient reported improvement of range of motion on the neck and reduction of pus discharge and pain (Fig 1, D).

DISCUSSION

In the literature, several medications have been reported for laser-assisted drug delivery for keloids and hypertrophic scars and include verapamil

Table I. Summary of studies using laser-assisted drug delivery of corticosteroids for keloids or hypertrophic scars

Study	Patients (n)	Indication	Treatment	Improvement	Complications
Waibel et al (2013) ⁶	15	Hypertrophic scars	Fractional CO ₂ laser followed by topical application of triamcinolone acetonide suspension (10 or 20 mg/mL), 3-5 treatments at 2- 3-mo intervals	Overall improvement: 2.73 on a 0-3 scale	None
Cavalié et al (2015) ⁷	23	Keloids	Fractional 2940-nm erbium laser followed by topical application of betamethasone cream under occlusion twice a day, treatments every other week until complete flattening of the scars or no further improvement, a median of 9 sessions (range, 3-29) performed	Median improvement: 50% (43% to 84%) Median patient satisfaction: 7/10 (3-10)	Hypochromia, eczematiform reaction, folliculitis, worsening of scars
Park et al (2017) ⁸	10	Keloids	Fractional erbium-YAG laser followed by intralesional injection of corticosteroid (10 mg/mL) (TAILI side) or topical application of desoxymethasone 0.25% ointment under occlusion (ODT side), 4 treatments at 6-wk intervals	VSS score TAILI side: 8.59 ± 1.23 (baseline), 4.56 ± 1.09 (after), ODT side: 8.31 ± 2.09 (baseline), 5.02 ± 0.87 (after) Moderate patient satisfaction on both sides	Peeling, telangiectasia, no serious adverse reactions
Kraeva et al (2017) ⁵	1	Keloid	Fractional CO ₂ laser followed by topical application of triamcinolone acetonide 0.1% ointment, 8 treatments at 6- to 8-wk intervals	Significant improvement in thickness, texture, and appearance High patient satisfaction	None
Waibel et al (2019) ⁴	20	Hypertrophic scar	Fractional CO ₂ laser followed by topical application of triamcinolone acetonide suspension (20 mg/mL) or 5-fluorouracil solution (50 mg/mL), 3 treatments at 1-mo intervals	Reduction of scar: 23% (triamcinolone acetonide side), 27% (5-fluorouracil side)	Dermal atrophy, telangiectasia

ODT, Topical application of desoxymethasone ointment under occlusion; TAILI, fractional erbium-YAG laser followed by intralesional injection of corticosteroid; VSS, vancouver scar scale; YAG, yttrium aluminum garnet.

hydrochloride,³ 5-fluorouracil,^{3,4} and steroids.⁴⁻⁸ Different vehicles of steroids have been used following laser treatments (Table 1). First, Waibel et al⁶ published a case series of 15 patients with hypertrophic scars treated with 3 to 5 sessions at 2- to 3-month intervals of fractional CO₂ laser with Deep FX setting immediately followed by application of triamcinolone acetonide suspension (10 or 20 mg/mL) with good results.⁶ In contrast, Cavalie et al⁷ treated patients with keloids with a 2940-nm ablative fractional erbium laser followed by topical betamethasone cream under occlusion twice a day every other week. The median improvement was 50%, and the median satisfaction rate of the patients was 7 of 10. Later Kraeva et al⁵ reported on a 39-year-old African-American man with a 20-year history of keloids on the posterior scalp treated with fractionated CO₂ laser immediately followed by topical triamcinolone ointment 6 to 8 weeks apart for a total of 8 sessions. Treatment was successful, and the clinical response was sustained 22 months posttreatment with no complications.⁵ Park et al⁸ also used ablative fractional erbium-yttrium aluminum garnet (YAG) laser for keloids. Following laser treatment, half of the lesions received an intralesional injection of corticosteroid, whereas the other half received topical application of corticosteroids under occlusion for 3 hours. Four treatment sessions were performed every 6 weeks, and both arms showed significant improvement. Waibel et al⁴ compared laser-assisted delivery of corticosteroids versus 5-fluorouracil for hypertrophic scars. Patients blindly received 3 treatments of fractional ablative CO₂ laser followed by either 50 mg/mL of 5-fluorouracil solution or 20 mg/mL of triamcinolone acetonide solution. Both modalities resulted in reduction in total surface area of scars, with 23% reduction noted with 5-fluorouracil and 27% reduction with triamcinolone acetonide. However, more complications, such as dermal atrophy and telangiectasias, were noted with steroids.⁴

To the best of our knowledge, this is the first case report of keloids successfully treated with fractionated ablative laser-assisted drug delivery with a combination of topical application and intralesional injections of steroids. This approach seems quite promising, as the patient noticed a flattening of keloids and improvement in pain and range of motion even after the first treatment despite a poor response to multiple intralesional injections of triamcinolone acetonide suspension alone. Additionally, the keloid on the upper back required only 3 treatments to achieve near-complete flattening (Fig 1, B). Other approaches, although very effective, did

not report immediate improvement (Table 1). Cavalie et al⁷ performed a median of 9 sessions (range, 3-29) of laser-assisted steroid cream delivery to achieve a median of 50% improvement. Waibel et al⁶ reported 23% of scar reduction after 3 treatments of fractional CO₂ laser followed by topical application of triamcinolone acetonide suspension alone. In the study by Park et al,⁸ patients reported improvement of keloid-related symptoms after the second treatment session. Although the Vancouver Scar Scale scores were 8.59 and 8.31 in laser followed by corticosteroid injection side and topical application of steroid ointment side, retrospectively, they decreased to 4.56 and 5.02 after 4 treatments. In comparison, our case showed more rapid response to the treatment.

We believe that the CO₂ laser facilitates absorption and penetration of the steroid into the keloids. Furthermore, we propose that a combination of topical application and intralesional injection of corticosteroid after laser treatments induces a more rapid and robust response to treatment with minimal adverse effects or downtime, although further studies are required to confirm this finding. This modality may represent a promising new approach in the treatment of extensive or refractory keloids that do not respond to traditional methods, and its therapeutic application warrants further exploration.

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