# Safety and Effectiveness of Fractional Ablative $CO_2$ Laser-Assisted Delivery of Topical Poly-L-Lactic Acid for Rhytides and Scars

Laser-assisted drug delivery (LADD) offers enhanced permeability and absorption of topical formulations, improving clinical outcomes compared with laser treatments alone.[1] Fractional ablative lasers, 1 vehicle for LADD, create microchannels in the skin allowing for deeper penetration and greater local bioavailability of topically applied formulations.[2] Poly-L-lactic acid (PLLA) is a synthetic, biodegradable dermal filler traditionally used as an injectable biostimulant of endogenous collagen production. Poly-L-lactic acid has been used in LADD to improve clinical outcomes from laser treatment of fine lines, wrinkles, scars, and skin texture. Since injected PLLA carries a risk of the formation of delayed inflammatory nodules, concern exists about a similar risk when applying PLLA topically in combination with LADD. Our group previously demonstrated the favorable safety profile of LADD with topical PLLA in a total of 94 patients who underwent 118 such treatments, all of whom had no such development of filler nodules or severe adverse events.[1]

At the high-volume laser clinic, the combination of a topically applied PLLA suspension immediately after treatment with fractional ablative $CO_2$ laser is routinely used. In the authors' experience, the synergistic effect of this combination treatment has yielded impressive clinical outcomes. We sought to formally evaluate the effectiveness of this treatment for a variety of indications, including rhytides, laxity, and scarring while also further summarizing the safety data.

A retrospective chart review of the electronic medical records was performed over a 3.5-year period from March 2018 to October 2021. Patients older than 18 years, who were treated with the fractional ablative $CO_2$ laser (Fraxel Repair, Solta Medical, CA) immediately followed by topical PLLA (Sculptra, Galaderma, TX), with a 4-week minimum follow-up and adequate comparable clinical photographs for evaluation, were included. Demographic and treatment information was collected (Table 1). The Global Aesthetic Improvement Scale (5-point scale:1—Worsened; 2—No change; 3—Improved; 4—Much improved; and 5—Very much improved) was used to grade clinical improvement comparing pretreatment photographs to the patient's follow-up visit photographs at a minimum of 4 weeks. Adverse events were recorded.

A total of 57 patients were included who underwent a total of 71 treatments with the fractional ablative $CO_2$ laser immediately followed by topical PLLA application (Table 1). Most of the patients were women (89.5%; $n$ = 51), with a median age of 61 years (R: 19–86 years). Although most were of Fitzpatrick skin type (FST) I–III (92.9%; $n$ = 54), this study set also included 4 patients who were of FST IV–V (7.1%).

Most patients (80.7%; $n$ = 46) had each area treated once (R: 1–3 treatments) for a variety of indications (Table 1). All treated sites were on the face or neck (Table 1). When recorded, the median total energy for laser treatment was 1.50 kJ and the median volume of PLLA was 1.5 cc.

When comparing pretreatment and post-treatment photographs, the median VAS improvement was graded as 4 (Much improved). Figurative examples of improvement are provided in Figures 1 and 2. Other than expected transient erythema that self-resolved post-treatment, there were no instances of filler nodules, delayed wound healing, prolonged erythema, dyspigmentation, or abnormal scarring.

Laser-assisted drug delivery facilitates synergistic laser and topical combinations that have the potential to augment overall treatment response by affording deeper penetration of topical suspensions within the dermis for maximal therapeutic effect. Such topicals have included analgesics, medications used in photodynamic therapy, 5-fluorouracil, corticosteroids, hyaluronic acid, tranexamic acid, and PLLA, among others.[3,4] Cadaveric studies have confirmed that the microchannels created through fractional ablative laser treatment are sufficiently sized for larger-sized PLLA particles (sized 40–63 μm) to pass through the stratum corneum and penetrate the dermis, where they can exert their biologic effects.[1]

Topical application of a PLLA suspension immediately following fractional ablative laser treatment has been shown to improve atrophic acne scars and rhytides of the upper lip in patients of FST I–III.[2,3] This study confirmed these findings and supports effectiveness in treating other etiologies of scarring, including atrophic surgical and traumatic scars, skin laxity, and fine-line spanning panfacial areas. A randomized controlled or split-site trial can help to elucidate the degree of clinical improvement attributed to treatment with the fractional ablative laser


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| TABLE 1. Patient and Treatment Characteristics | |
|---|---|
| | ***N* (%), Total *N* = 57, 71 Treatments** |
| Sex | |
| Female | 51 (89.5) |
| Male | 6 (10.5) |
| Median age | 61 (R: 19–86) |
| Fitzpatrick skin type | |
| I-III | 53 (92.9) |
| IV-V | 4 (7.1) |
| Treatment indications | |
| Photodamage | 17 (29.8) |
| Fine lines/rhytides | 11 (19.3) |
| Skin laxity | 7 (12.3) |
| Traumatic scars | 12 (21.1) |
| Acne scars | 10 (17.5) |
| Anatomic sites | |
| Full face | 10 (17.5) |
| Upper lip | 18 (31.6) |
| Perioral complex | 8 (14) |
| Cheeks | 6 (10.5) |
| Glabella | 2 (3.5) |
| Forehead | 2 (3.5) |
| Chin | 2 (3.5) |
| Nose | 2 (3.5) |
| Periorbital complex | 1 (1.8) |
| Non–full-face multiple sites | 6 (10.5) |

versus topical PLLA suspension and/or the synergy of the 2 modalities; however, the authors believe strong clinical outcomes, occurring most often with just 1 treatment (80.7%), are likely attributable to synergistic interactions of the laser therapy and the topically applied PLLA.[2] Targeted tissue damage induced from the laser mobilizes epidermal stem cells to replace damaged skin and activates cytokines, including tissue necrosis factor-alpha (TNF-alpha) and transforming growth factor-beta (TGF-beta), to replace the damaged collagen and synthesize new collagen.[2] Poly-L-lactic acid has also been shown to induce neocollagenesis by direct activation of fibroblasts as part of a local tissue inflammatory response.[5]

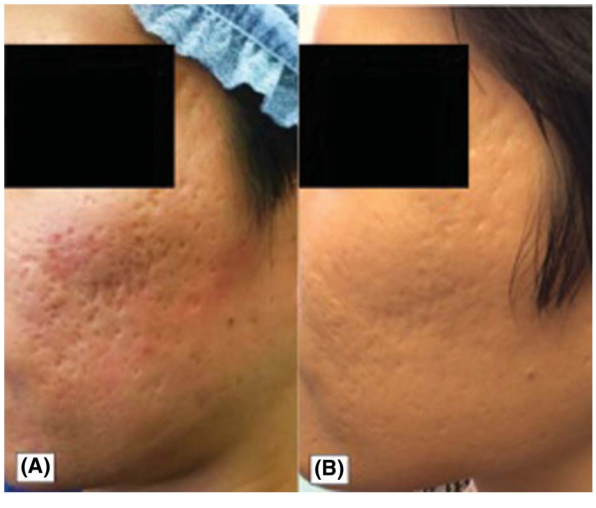


**Figure 1.** Patient with significant atrophic boxcar acne scarring before (A) and after (B) 1 treatment with fractional ablative $CO_2$ laser-assisted delivery of poly-L-lactic acid suspension.

In an earlier study by the authors using combined fractional ablative LADD with topical PLLA, no adverse events occurred in 94 patients who received a total of 118 treatments over 2.5 years.[1] Similarly, among the 71 treatments administered in this study, there were no adverse events. Subcutaneous papules and nodules, commonly reported adverse events with injected PLLA, were neither seen in this study nor have been seen clinically in the many years that the authors have used this treatment modality, likely due to the lower volumes and superficial depths of the administered PLLA through the microscopic laser channels. Notably, the authors have also never seen nodule formation using this technique in areas with thinner skin, such as the periorbital and perioral areas, where the rate of inflammatory reactions and nodule formation of injected PLLA is believed to be higher.[3] Among patients of all skin types, including 4 patients of FST IV–V, there was no prolonged erythema or abnormal scarring.

This real-world study highlights the favorable safety profile and high effectiveness of fractional ablative $CO_2$ laser-assisted delivery of topical PLLA in a variety of skin


**Figure 2.** Improvement in perioral rhytides before (A) and after (B) 1 treatment with fractional ablative $CO_2$ laser-assisted delivery of poly-L-lactic acid suspension.

types and for multiple indications, including atrophic scarring of multiple etiologies, as well as facial rhytides. While limitations of this study include its retrospective nature and single-center design, additional prospective, controlled, and/or split-site studies with large cohort sizes can be beneficial to further validate these results.

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