

ORIGINAL ARTICLE

An Innovative Device for Fractional CO₂ Laser Resurfacing: A Preliminary Clinical Study

Daniel A. Cassuto, MD; Neil S. Sadick, MD; Luca Scrimali, MD; Paolo Siragò, MD

Background and Objective: Use of CO₂ laser resurfacing is a powerful tool for the treatment of several skin conditions, such as fine and coarse wrinkles, scars of various origin, uneven pigmentation, and dilated pores. Some major drawbacks have progressively limited its use: the need for effective anesthesia, the downtime associated with treatment, the risk of hyperpigmentation and scarring, the need for intensive postoperative care, the long-lasting erythema, and the need to avoid sun exposure for extended periods. Fractional laser resurfacing with a 1540-nm laser can avoid some of these disadvantages, but pain and cost still serve as barriers. A new CO₂ laser system with a fractional modality added to a traditional though potentially very rapid scanner was tested as a tool for skin rejuvenation. It can perform traditional and fractional resurfacing at depths ranging from 20 to 500 μm and treating 20%, 40%, or 100% of the scanned area.

Materials and Methods: A series of 24 consecutive patients (Fitzpatrick skin types II–IV) were treated with one pass of the aforementioned fractional CO₂ laser (18 faces, 2 necks, 8 hands). No anesthesia was used. The power used was between 8 and 15 W, with SX index values of 4 to 8, according to patient tolerance. SX index indicates pulse width: the shorter the pulse the higher the SX index value. Postoperative management included a thermal water-based cream and makeup provided free of charge. Digital clinical macrophotography was used to assess the results and a subjective pain and satisfaction evaluation was also done.

Results: All patients showed improvement in skin texture and color after one treatment. Undesired postoperative effects were immediate erythema, and swelling that subsided within 24 hours. Fine pinpoint microcrusting occurred in all cases, but it resolved within 1 week on the face and 10 days

on the other body areas. The treatment was well tolerated. With makeup it looked like a tan. No long-term side effects were observed after 6 months of follow-up.

Conclusions: The evaluated system is an effective and safe tool for skin rejuvenation by fractional laser resurfacing.

Use of CO₂ laser resurfacing is a powerful tool for the treatment of several skin conditions, such as fine and coarse wrinkles, scars of various origin, uneven pigmentation, and dilated pores.^{1,2} Some major drawbacks have progressively limited its use: the need for effective anesthesia, the downtime associated with treatment, the risk of hyperpigmentation and scarring, the need for intensive postoperative care, the long-lasting erythema, and the need to avoid sun exposure for extended periods of time.^{3–7}

Fractional photothermolysis was introduced by Huzaira and colleagues in 2003.⁸ It was developed to overcome the aforementioned drawbacks in the treatment of photodamaged skin. Fractional laser resurfacing with the mid-infrared lasers uses an invisible laser beam, which is strongly absorbed by water in order to reverse the effects of skin aging and scarring.⁹ Near infrared wavelengths (1550 nm, Fraxel, Reliant Technologies, Mountain View, CA; Lux 1540, Palomar Medical Technologies, Burlington, MA) cause significant pain and require some form of anesthesia.¹⁰ They are also time-consuming and costly. Another disadvantage is that most of these devices are only capable of performing one kind of treatment.

The use of ablative lasers in a fractional mode was introduced in 2006 (A. Kauver, oral communication). The lesser depth of immediate tissue necrosis, in comparison with the mid-infrared wavelengths, together with the possibility of further heat deposition in the dermis, significantly reduces the pain caused by the procedure without decreasing its efficacy. A new CO₂ laser (10600 nm, Active FX, Lumenis Inc., Yokneam,

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From the Department of Plastic Surgery, University of Catania, Catania, Italy (Dr Cassuto, Dr Scrimali, Dr Siragò) and Weil Medical College of Cornell University, Department of Dermatology, New York (Dr Sadick).

Corresponding author: Daniel Cassuto, MD, Piazza V Giorante, 1-20129 Milano ITALY (e-mail: daniel.cassuto@fastwebnet.it).

Table 1. Overview of Infrared Fractional Lasers and Their Features*

Laser Feature	Mixto SX Slim Evolution Lasering	Encore Lumenis Inc.	Pixel Alma Lasers Ltd.	Lux 1540 Palomar Medical Technologies	Affirm Cynosure Inc.	Fraxel Reliant Technologies
Wavelength	10.600 nm	10.600 nm	2940 nm	1540 nm	1440 nm	1550 nm
Type of emission	Continuous/pulsed	Pulse	Pulse	Pulse	Pulse	Continuous
Beam spot size	0.3 mm	1.3 mm	0.7 mm	0.2–0.3 mm
Scanned area	20 × 20 mm	14 × 14 mm	11 × 11 mm	10–15 mm	10 mm	...
Scanner	Yes	Yes	No	Yes	No	Yes
Mode	Ablative	Ablative	Ablative	Nonablative	Nonablative	Nonablative

*Mixto SX, Slim Evolution, Lasering, Modena, Italy; Encore Lumenis Inc., Yokneam, Israel; Pixel Alma Lasers Ltd., Caesarea, Israel; Lux 1540, Palomar Medical Technologies, Burlington, MA; Affirm Cynosure Inc., Westford, MA; Fraxel, Reliant Technologies, Mountain View, CA.

Israel) with less penetration was shown to be more tolerable, but the 1.3-mm spot still makes some local anesthesia and/or cooling necessary. The spot distribution is uniform as with the mid-infrared devices. A more recent CO₂ laser system (Slim Evolution, Lasering, Modena, Italy) with a microspot system (300 μ) fractional modality (Mixto SX) has been developed with a new scanning algorithm that keeps the longest possible interval between 2 adjacent spots, in order to minimize the heat accumulation around the treated areas. This is supposed to significantly reduce the pain during the procedure. An overview of the characteristics of several fractional devices is shown in Table 1.

Objective

A new CO₂ laser system (Slim Evolution, Lasering) with a unique fractional modality (Mixto SX) added to a high-speed scanner was tested as a tool for skin rejuvenation. It will be tested to evaluate its efficacy and tolerability as a tool for skin rejuvenation without any form of anesthesia or cooling.

Materials and Methods

The Mixto SX system (Lasering) is a fractional CO₂ laser equipped with a new generation computerized pattern generator. Its recently developed algorithm allows the 300-μm beam to be delivered at intervals that greatly increase its tolerability. The pattern results in a precise beam delivery over the treated area. The operator can choose to be selectively more aggressive in treating areas that are particularly scarred or sun-damaged areas as needed. The laser can perform traditional and fractional resurfacing at depths ranging from 20 to 500 μm, treating 20% or 100% of the scanned area. The traditional single beam is also available for vaporizing solid lesions or cutting purposes. A series of

24 consecutive patients (Fitzpatrick skin types II–IV) were treated with one pass of the aforementioned fractional CO₂ laser (11 faces, 5 necks, 8 hands). No anesthesia or skin cooling were used. The power used was between 8 and 10 W, with SX index values of 6 to 8, according to the indication and to patient tolerance. A single pass was done over the whole area.

Postoperative management included a thermal water-based cream (Cicalfate, Avène, France) and makeup provided free of charge. Pain tolerance was measured with a 0–5 score (Table 2). Digital clinical microphotography was used before and 3 months after treatment. An independent evaluator assessed the results according to the scale shown in Table 3. All patients completed satisfaction questionnaires stating how strongly they would recommend the treatment to their friends. To eliminate the bias in satisfaction questionnaires (Table 4) all patients were charged for the treatments.

Results

All patients showed significant improvement in skin texture and color after one treatment. All patients tolerated the treatment sessions. The mean pain score was 1.8 (a score of 2 = easily tolerated). The average improvement score given by the independent evaluator

Table 2. Pain Score Scale

Score	Description
0	Not Felt
1	Barely Felt
2	Easily Tolerable
3	Tolerable
4	Barely Tolerable
5	Unbearable

Table 3. Criteria for Evaluating the Results by Digital Photography

Score	1	2	3	4
Improvement (%)	0–25	25–50	50–75	75–100

Table 4. Subjective Satisfaction Criteria

Score	1	2	3	4
Patient's recommendation	Not at all	Uncertain	Positive	High

was 3.83. Postoperative undesired effects were immediate erythema and swelling that subsided within 24 hours. Fine pinpoint microcrusting (Figure 1) occurred in all cases and resolved within 1 week. With makeup camouflage the erythema looked like an exaggerated tan and was well-tolerated.

All patients expressed almost unanimously, full satisfaction from the laser treatment (mean satisfaction score was 3.958). There were no dropouts. Overall treatments were well tolerated, and there was no downtime. No long-term side effects were observed after 6 months of follow-up. Examples of the results are visible in Figures 2 and 3.

Discussion

Like other ablative fractional lasers, patients found the Mixto SX to be more tolerable than the mid-infrared devices that penetrate more deeply into the tissue. However, damage at a lesser depth did not result in less efficacy because irreversible damage to the deep tissue is not necessary in order to stimulate rejuvenation by

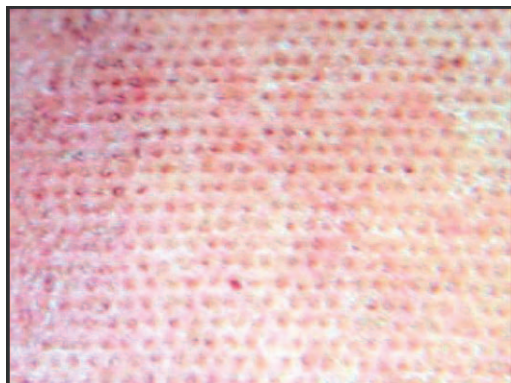


Figure 1. Highly magnified appearance of the microcrusting 48 hours after treatment. Each microcrust has a 300-µm diameter.



Figure 2. A 41-year-old patient with a Mediterranean skin type and moderate sun damage. Left photo: before treatment. Right photo: 3 months after treatment. Notice the improvement in skin texture and color. The fine wrinkles are almost erased from the cheek.

shrinkage (immediate) and new collagen formation (after 6 to 12 weeks). This effect is readily achieved by the lower SX indexes, which cause a further heat delivery after the initial ablation. Varying the power (watts) can regulate the depth of this ablation. This versatility is quite promising: it allows the operator to adjust the settings according to the different areas of the body, skin thickness may vary from 150-µm as in an aged lid to a few millimeters on the forehead. Alternatively, the operator can make an overlapping scanned spot with a 45° angle of rotation to achieve a microspot density of about 40%. This technique is particularly useful when treating areas with more severe photoaging (senile stains, deeper wrinkles) without resorting to more aggressive settings that would increase the pain. Localized slight erythema, lasting 1

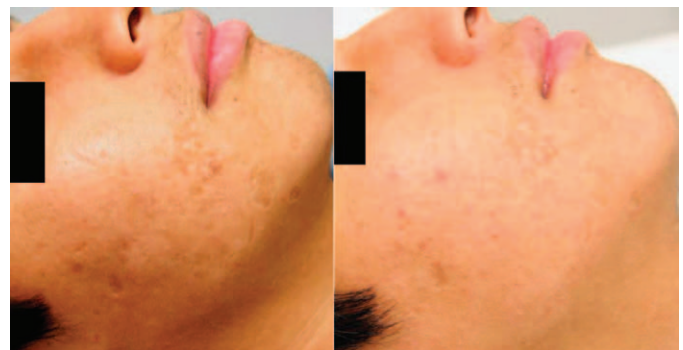


Figure 3. A 19-year-old Hispanic patient with hyperpigmented severe acne scarring. Left photo: before treatment. Right photo: 3 months after treatment (2 sessions with a 1-month interval). The improvements in skin color and scar remodeling are visible.

to 2 weeks, should be expected in these areas. Solid benign lesions, such as skin tags or seborrheic keratoses, can be ablated during the same treatment. Switching to a single beam emission for bloodless ablation or incision is done by making changes through the touch screen in 3 seconds, without changing the handpiece. A comparison to other fractional devices is shown in Table 5.

Eliminating the need for anesthetic creams, chromophore gels, and other water-based preparations will ensure that the water content of the skin is not altered before treatment. This is particularly important when using infrared wavelengths that are mainly absorbed by water (P. Bjerring, oral communication, 2007) as in fractional resurfacing and photothermolysis.

Tips and Tricks

The following advice should be useful for those who approach the first treatments with the Mixto SX:

- Topical anesthesia is not required for most patients. This should be discussed with patient before treatment.
- Avoid treatment on premenstrual days.
- Wash the patient’s skin thoroughly and let it dry before treatment.
- Cover the patient’s eyes with nonreflecting protective goggles or water-soaked gauze.
- Treatment is safe for the face, neck, chest, and hands.
- Initial settings are power at 8 W and index at 8. The patient will not experience any discomfort at this “soft” setting.
- For treatment of wrinkles, the power setting remains

at 8 W. The index setting will vary according to skin type and depth of wrinkles. Reduce the index setting to increase the exposure time and spot penetration. The new index setting should be where the patient feels bearable discomfort but no pain. To treat deeper wrinkles, prescribe an oral painkiller 1 hour before the procedure. This will enable the patient to be treated at a lower SX index.

- For treatment of acne scars, the index setting remains at 8. The power setting will vary according to skin type and severity of the acne scars. Increase the power setting until the desired effect on tissue is achieved. The patient should feel no pain. To treat deeper scars, prescribe an oral painkiller 1 hour before the procedure. This will enable the patient to sustain a higher power.
- The treatment area can be adjusted from 6 × 6 mm to 20 × 20 mm at increments of 2 mm.
- After fractional resurfacing, the laser can be switched to traditional CO₂ mode for ablation of skin growths (eg, skin tags, seborrheic keratoses) or to traditional resurfacing mode in selected areas.
- After treatment do not wipe the treated area. The eschar will promote the healing process. The patient will experience a burning sensation on the skin that lasts between 30 minutes and 3 hours. Apply a fragrance- and preservative-free moisturizer to the treated area. After 1 to 2 days, the erythema will be replaced by a progressively darkening sun-tanned look. At this point, makeup can be applied.
- The expected downtime is up to 5 days for the face,

Table 5. Overview of the Treatment Features of Different Fractional Devices*

	Mixto SX Slim Evolution Lasering	Encore Lumenis Inc.	Pixel Alma Lasers Ltd.	Lux 1540 Palomar Medical Technologies	Affirm Cynosure Inc.	Fraxel Reliant Technologies
Time per session (total face) including immediate pre- and posttreatment processes	20 minutes	80 minutes	20 minutes	80 minutes	80 minutes	120 minutes
Sessions	1	1	1	4	4	4
Anesthesia	No	Topical	No	Topical + Coolant	Topical + Coolant	Topical + Coolant
Posttreatment side effects	Erythema	Erythema	Erythema	Erythema + Edema	Erythema + Edema	Erythema + Edema
Downtime (face)	4–6 days	4–6 days	4–6 days	6–8 days	6–8 days	6–8 days
Downtime (décolleté and hands)	7–10 days	7–10 days	7–10 days	10–12 days	10–12 days	10–12 days
Tightening	Yes	Yes	Yes	No	No	No

*Mixto SX, Slim Evolution, Lasering, Modena, Italy; Encore Lumenis Inc., Yokneam, Israel; Pixel Alma Lasers Ltd., Caesarea, Israel; Lux 1540, Palomar Medical Technologies, Burlington, MA; Affirm Cynosure Inc., Westford, MA; Fraxel, Reliant Technologies, Mountain View, CA.

up to 7 days for the neck, and up to 10 days for the chest or hands.

- Superficial wrinkles and skin defects usually disappear after 1 session. Deeper wrinkles and acne scars may require 2 or 3 sessions, spaced 1 month apart.

Conclusions

The Mixto SX is an effective and safe tool for skin rejuvenation by fractional laser resurfacing. Its versatility allows the operator to perform minimally invasive treatments, together with more aggressive resurfacing and/or tissue ablation if needed. The remarkable tolerability makes its acceptance by patients easier and eliminates the need for cumbersome and time-consuming cooling or aesthetic procedures. The results are reproducible without need for any gel or other substance to be applied.

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