ORIGINAL ARTICLE

Combination Laser Resurfacing With Facial Plastic Surgery Is Superior to Lasers Alone

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Introduction: *This study was designed to demonstrate through validated objective wrinkle scales that the combining of facial plastic surgery with fractionated CO_2 lasers in the perioperative setting is superior to CO_2 laser only in the treatment of rhytidosis.*

Materials and Methods: *Data were gathered and reviewed from 2 patient groups who were treated with either combined facial plastic surgery with fractionated CO_2 lasers or laser-only therapy. Surgeries were performed by the senior author (J.E.B.) at a level 1 trauma center from July 2009 through May 2014. Preoperative and postoperative photographs were gathered for all patients and distributed in random order to a facial plastic surgeon and a dermatologist who objectively rated them. Both raters were blinded to patient data and treatment information. The study included 32 patients (30 females and 2 males). Nineteen patients received adjunctive fractionated CO_2 laser resurfacing in the setting of facial plastic surgery; the second group consisting of 13 patients was treated with fractionated CO_2 laser only. Surgeries performed included blepharoplasty, deep plane rhytidectomy, forehead rhytidectomy, submental liposuction, and rhinoplasty. Raters used validated scales to objectively assess the 2 patient groups. These included the Glogau, Fitzpatrick, and Modified Fitzpatrick scales. Numerical values were assigned to before and after pictures of patients in the frontal and profile views.*

Results*: Patients treated with the combination of laser plus facial plastic surgery showed a greater decrease in wrinkles than patients treated with laser-only therapy (estimate= −0.78, P = .07) when evaluated with the Glogau scale. In addition, younger patients and patients with darker pigmentation showed a greater reduction in wrinkles compared with their counterparts (estimates negative, P values <.001).*

Discussion*: A combined technique using facial plastic surgery in conjunction with fractional CO_2 laser resurfacing is superior in treating rhytidosis in comparison to fractional CO_2 laser-only treatment. This technique can be used safely in a wide range of patients and is convenient and cost-effective.*

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Introduction

The role and place of laser resurfacing is rapidly evolving in the field of facial plastics. Used alone, the laser has enjoyed success in the treatment of facial scars, lesions, and rhytidosis. The fractionated CO_2 laser has become especially popular in recent years because of its excellent results with decreased recovery time after surgery.[1] Its use as an adjunctive treatment along with other facial plastic procedures is now coming under debate. We have learned that different therapies may indeed be complementary and even synergistic. As one example, pretreatment with botulinum toxin before laser therapy offered significantly improved results compared with laser alone in a blinded and randomized study.[2] Some surgeons are now using the fractionated CO_2 laser in the same perioperative period as traditional deep plane rhytidectomy, rhinoplasty, blepharoplasty, and dermal filler injections. Proponents claim an enhanced effect when these therapies are combined and a more convenient and overall improved outcome for the patient.[3]

Although there are several documented reports demonstrating the favorable outcome of combining facial

Table 1. Comparative Patient Demographics in Treatment Groups LF and L*

Treatment group LF	
Age (y)	39–75
Surgeries	Blepharoply (15), deep plane rhytidectomy (15), submental liposuction (9), forehead rhytidectomy (5), rhinoplasty (5)
Active CO_2 laser settings	80–125 mJ/3–5 D/200–600 Hz
Deep CO_2 laser settings	15–20 mJ/10–15 D/400–600 Hz
Fillers	Juvederm (2), Restylane (3)
Total patients	19
Treatment group L	
Age (y)	36–81
Active CO_2 laser settings	80–125 mJ/4–5 D/250–600 Hz
Deep CO_2 laser settings	15–20 mJ/0.5–20 D/300–600 Hz
Fillers	Juvederm (4), Radiesse (2), Restylane (2)
Total patients	13

*LF indicates laser plus facial plastic surgery; L, laser only.

plastic surgery with fractionated CO_2 lasers, none of these have objectively compared the results with those of noninvasive methods such as laser-only therapy. The goal of this retrospective cohort is to demonstrate through validated objective wrinkle scales that the combining of facial plastic surgery with fractionated CO_2 lasers in the perioperative setting is superior to CO_2 laser only in the treatment of rhytidosis.

Materials and Methods

All patients were treated in the Facial Plastics and Dermatology Department at San Antonio Military Medical Center from July 2009 through May 2014 by the senior author (J.E.B.). Data from 2 groups of patients were gathered and reviewed. Groups consisted of patients who received combined facial plastic surgery with fractionated CO_2 laser and patients with CO_2 laser-only treatment. Both groups gave informed consent and were counseled appropriately. Anesthesia for the procedures included local, conscious sedation and general anesthesia in accord with patient and surgeon preferences. All patients' medical records were thoroughly reviewed for information such as history of facial plastic surgery, resurfacing, or any supplementary procedures. Patient information such as age, surgeries performed, and active or deep laser settings are shown in Table 1. Institutional review board approval was obtained before reviewing patient data.

Photographs were taken in a neutral expression before and after surgery in frontal and profile views of the face. All photographs were taken at the same level of chin elevation and zoom. Preoperative photographs were taken an average of 1 month before surgery, ranging from 7 to 41 days before surgery. Postoperative pictures were taken an average of 3 months after surgery, ranging from 60 to 120 days after surgery.

Preoperative and postoperative digital photographs of both treatment groups were combined in a random fashion for raters to review. In addition, preoperative images were randomized with postoperative images. Two raters assessed the photographs, 1 fellowship-trained facial plastic surgeon (rater A) and 1 dermatologist (rater B). Both physicians were blinded to patient data and treatment procedures. Raters were given Fitzpatrick, Glogau, and Modified Fitzpatrick scales and were instructed to assign values from each scale to each set of frontal and profile photographs based on their experience. Raters were also asked to estimate the patients' apparent age for all preoperative and postoperative photographs, which again was done in a randomized fashion.

J.E.B. performs deep plane rhytidectomy by deep plane technique as described by Sykes et al.[4] All surgeries were performed prior to laser treatment as outlined in Table 1. Patients who received dermal filler placement were injected immediately after the laser resurfacing. Dermal filler placement was performed in both patient groups using a standard threading technique. Restylane and Juvederm were injected into the mid to deep dermis. Radiesse was injected into the immediate subdermis.

In our institution, we use the Lumenis Ultrapulse fractionated CO_2 laser. All patients were given prophylactic treatment with valacyclovir. The face was

washed with acetone preoperatively. The settings varied on a patient and surgeon basis and are described in Table 1. All treatments used the hexagonal shape size 3. All patients received full-face treatments with varied settings by subunit, and neck treatments were likewise done in all patients at a setting of 100 mJ fluence, density 4, and 300 Hz. The skin was cleaned at the conclusion of the procedure with saline. Patients were instructed to apply petroleum topical moisturizer for 3 days followed by an over-the-counter topical moisturizer, standard wound care, and sun prevention for 1 month.

Statistical Analysis

The data obtained from this study presented some methodological challenges that we had to account for in our choice of inferential technique. First, each patient and physician made a considered decision about whether to undergo laser-only (referred to in the following as treatment group L) or laser plus facial plastic surgery (treatment group LF). Accordingly, there is almost assuredly a selection bias stemming from correlations between the treatment group and the patient outcomes (e.g., Glogau rating after treatment). Second, there may be systematic rater biases (e.g., based on professional experience and training) that should be tested and accounted for.

Considering that we must account for both patient characteristics and rater idiosyncrasy, regression is a natural choice for a statistical technique. As the data are ordinal and categorical, the best choice of statistical model is the cumulative link model proposed by McCullagh (1980) and implemented in the R package ordinal.[5,6]

Results

Two groups consisting of 32 total patients were included in this study. Patients included in the study were selected based on availability of before and after photographs and specific documentation of all surgeries and procedures performed. The first group consisting of 19 patients received adjunctive fractionated CO_2 laser resurfacing in the setting of facial plastic surgery as deemed appropriate by the surgeons and patients. Four of these patients were treated first with facial plastic surgery, with an average of 522 days (range, 92–1174 days) between surgery and laser treatment. The remaining 15 patients were treated with CO_2 laser and facial plastic surgery simultaneously. The second group consisting of 13 patients was treated with fractionated CO_2 laser only (Table 1).

Figure 1. *Patient in the laser plus facial plastic surgery (LF) treatment group, before (left) and after (right). Procedures performed include bilateral upper blepharoplasty, bilateral forehead rhytidectomy with deep plane rhytidectomy, and submental liposuction. Active FX CO2 laser settings as follows: frontal, 100 mJ/5/400 Hz; infraorbital, 80 mJ/4/400 Hz; perioral, 100 mJ/5/400 Hz; cheek, 80 mJ/4/400 Hz. No deep FX used.*

Among treatment group LF, blepharoplasties were done in 15 patients, deep plane rhytidectomies in 15 patients, submental liposuction in 9 patients, forehead rhytidectomy in 5 patients, rhinoplasty in 5 patients, and dermal fillers in 5 patients. In treatment group L, 6 patients received dermal fillers. Similar CO_2 laser settings were used in both treatment groups, falling within the following ranges for active FX: energy 15–25 mJ, density 0.5–20, and frequency 300–600 Hz. Deep FX settings were as follows: energy: 50–125 mJ, density 3–5, frequency 125–600 Hz. The surgical and laser treatments for both patient groups are outlined in Table 1. There were no complications related to the use of the laser on undermined and nonundermined skin. There were no operative or postoperative complications noted in any of the patients. No revision surgery or treatments have been necessary. Patients from both treatment groups have illustration pre- and postoperative photographs included (see Figures 1 and 2).

Among the data analyzed, the scores assigned by raters using the Glogau scale produced the most significant results. Using Glogau ratings after the procedure as the response variable, the LF treatment factor estimate showed a strong negative association of −0.78 with a P value of .07. This finding suggests that combination therapy with laser and facial plastic surgery produces a greater reduction in Glogau rating than laser-only therapy with a P value significant at the

Figure 2. *Patient in the laser-only (L) treatment group, before (left) and after (right). CO2 laser settings are as follows: active FX, 125 mJ/5/125 Hz; deep FX forehead, 15 mJ/5/400 Hz; eyelids, 15 mJ/3/400 Hz.*

10% confidence level. Figure 3 is a graphic comparison of the Glogau ratings before and after procedures in the 19 patients from treatment group LF.

In our analysis of the ratings produced between raters A and B, the rater fixed effect was calculated with a *P* value of .61, which indicates that we were unable to find a significant disagreement between the raters in their assessment of the 2 patient groups. The relationship between patients with darker complexion (Fitzpatrick 3/4/5) on the Glogau score is negative (−1.42) with a small *P* value (<.01). Those patients' Fitzpatrick skin types 3–5 showed a significantly greater reduction in Glogau score than did those with Fitzpatrick skin type 1 and 2. Simply stated, patients with darker complexion showed a greater improvement. Estimated age showed a positive correlation with the Glogau after ratings with a factor estimate of 0.10 and a very small *P* value of <.01, confirming our intuition that the more wrinkles the patients had, the older they were estimated to be by our raters.

In addition, the Glogau 3/4 (before) effect on the Glogau score after the procedure is positive (1.61) and the *P* value is small (.02), confirming our intuition that patients with higher Glogau ratings before surgery will tend to have higher Glogau ratings after surgery. The estimated age effect is positive (0.10), with a small *P* value of <.01. A summary of these values is shown in Table 2.

We also included the Modified Fitzpatrick scale (before procedure) as an explanatory term, but none of the estimates were statistically significant. We arrived at the model shown in Table 2. In this data set,

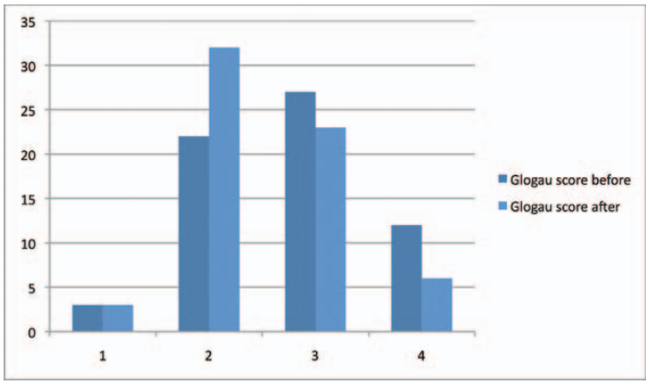

Figure 3. *A graphic comparison of Glogau ratings before and after surgery in treatment group laser plus facial plastic surgery (LF).*

there is evidence of some disagreement between the raters with a strong rater fixed effect (−1.29 when rater A is rating) and a small *P* value (<.01). To determine whether this disagreement may be confounding the results, we ran 2 separate model estimations for rater A's ratings and rater B's ratings. For both models, the only statistically significant effect was from the patient's estimated age before surgery. It is important to note that, while there is not enough evidence to conclude that L and LF have no difference in Modified Fitzpatrick ratings after procedure, the results are not incongruous with the results obtained by analyzing the Glogau ratings. Further analysis of the data showed a great deal of variability between the Glogau and Modified Fitzpatrick ratings, further supporting the idea that a lack of evidence for L versus LF treatment effect in Modified Fitzpatrick does not contradict the strong results for the Glogau ratings.

Discussion

Lasers have enjoyed a role in the world of cosmetic surgery for years. The CO_2 laser was first developed by Bell Laboratories in 1964, with medical applications coming a few years later in the 1970s. In 1993, the first skin-resurfacing procedure using high-energy CO_2 lasers was performed. By the late 1990s, their use in skin resurfacing was en vogue. Although fractionated CO_2 lasers are still a relatively new therapy for skin resurfacing, they are becoming more widely accepted for the use of treating facial rhytids and are an effective noninvasive tool in facial cosmetics. In a study evaluating apparent age, Swanson found that CO_2 laser resurfacing reduced apparent age by 2.5 years.[7] In recent years, fractionated CO_2 laser therapy has also been

Table 2. Estimates and *P* Values for a Probit Cumulative Link Model Using Glogau and Modified Fitzpatrick Ratings After the Procedure as the Response Variable*

	Estimate	*P* Value
Response variable (Glogau)		
Treatment (LF)	−0.78	.07
Rater (A)	−0.18	.61
Estimated age (before)	0.10	<.001
Fitzpatrick 3/4/5 (before)	−1.42	<.001
Glogau 3/4 (before)	1.61	.02
Response variable (Modified Fitzpatrick)		
Treatment (LF)	−0.06	.83
Rater (A)	−1.29	<.001
Estimated age (before)	0.06	.02
Fitzpatrick 3/4/5 (before)	−0.54	.09
Glogau 3/4 (before)	0.15	.71

*LF indicates laser plus facial plastic surgery; L, laser only.

shown to significantly improve photoaging of the face, a reduction in rhytidosis, and overall cosmesis.[1,8,9]

While CO_2 lasers remain the minimally invasive standard of photoaging treatment and offer significant benefits, our goal in this cohort study was to demonstrate the superior outcome of combining lasers with facial plastic surgery in the treatment of facial rhytids. Combination therapy has been the subject of debate and controversy. Detractors worry about the risks of combination treatment with concern for flap necrosis after laser treatment.[10,11] Spira et al[12] summarized this notion by advising never to "insult the skin by peeling and undermining the same area simultaneously." However, a large meta-analysis performed by Koch and Perkins[3] demonstrated the safety of combined laser and surgery in more than 400 patients with ablative, nonfractionated CO_2 laser. From this knowledge, one could infer that fractionated CO_2 would likewise be safe.

Although no large-scale studies exist for this technique, surgeons (including this article's senior author, J.E.B.) are now using the fractionated CO_2 laser in the same perioperative period as traditional deep plane rhytidectomy, rhinoplasty, blepharoplasty, and dermal filler injections with favorable results.[3,13] Of note, patients tend to rate themselves younger when undergoing combined procedures in comparison with those with laser-only treatments.[12,14]

We demonstrate in this cohort study that combination laser resurfacing with facial plastic surgery is superior to laser resurfacing alone, a finding that has not been reported in the literature previously. The LF treatment factor estimate of −0.78 (see Table 2) can be interpreted as follows: laser and facial plastic surgery together tend to reduce the Glogau rating for a patient more than laser treatment alone. The .07 *P* value gives us fairly strong evidence that the true effect of additional facial plastic surgery on Glogau rating is non-zero.

It is worth noting that the patients in this study who benefitted the most from the therapy were those with darker pigmented skin and patients with a lower estimated age. The Fitzpatrick 3/4/5 and estimated age effects control for Glogau rating before surgery, so their effects isolate relative effectiveness of the procedures. Those with higher Fitzpatrick scores (3, 4, and 5) had a strong association with a greater reduction in Glogau score after surgery in comparison with patients with a Fitzpatrick score of 1 and 2 (estimate of −1.42 with a *P* value of <.01). In addition, as apparent age increases, there is a lesser reduction in the postsurgery Glogau score, demonstrating a greater benefit from treatment among younger patients.

The reason that patients with darker complexion showed a greater improvement is unclear but may be useful in appropriating a treatment plan with patients of differing ethnicities. The greater benefit to younger patients may have resulted from an unbalanced data set. Perhaps there was a larger ratio of older patients to younger patients who elected for more aggressive therapy (combination therapy). Whatever the explanation, we can see that patients young and old can benefit from a combined technique.

The rater fixed-effect *P* value of .61 indicates that we have insufficient evidence to conclude that the

raters have systematic differences in rating patients on the Glogau scale. In other words, rater A and rater B showed no significant disagreement between the raters in their assessment of the patients, and thus the results and scale are reliable.

Patients receiving combination therapy had a very slight association with a lower Modified Fitzpatrick score after surgery (estimate of −0.06) and we were unable to demonstrate the same significance with the Modified Fitzpatrick scale (*P* value .83). This was perhaps due to our raters' unfamiliarity with the scale, as it is a scale not commonly used today. Neither rater had seen or used the scale before rating the patients in this study. Perhaps this finding offers insight into why the Glogau scale has become a more mainstream scale for accurately measuring rhytidosis over other available scales.

In our experience, combining fractionated CO_2 laser resurfacing with surgery did not result in any complications, consistent with results seen by Koch and Hollmig. We have seen that combination therapy is a safe treatment option that delivers quality aesthetic results with minimal downtime and operating expense. Patients enjoy having combination therapy because it is less expensive, there is less painful overall, and it is more convenient for them to recover from a single operation than from staged treatments. Facial plastics may well be entering into a new treatment paradigm that maximizes treatment benefit with combination therapy.

This investigation gives important insight into the benefit of combining laser and facial plastic techniques with a *P* value of .07. However, because of the relatively small sample size, room still remains for further investigation. Although there are no current plans in place to conduct a larger trial, we hope that the results of this study will inspire researchers to further explore and outline the effects of the combined use of fractionated CO_2 lasers and facial plastic surgery. We add our experience to those of our fellow clinicians to continue demonstrating that this procedure has repetitively been performed safely with excellent results to improve wrinkles and facial cosmetics.[1,3,8,9,13]

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