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ORIGINAL ARTICLE

Random fractional ultrapulsed CO_2 resurfacing of photodamaged facial skin: long-term evaluation

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Abstract Although numerous papers have recently been published on ablative fractional resurfacing, there is a lack of information in literature on very long-term results. The aim of this retrospective study is to evaluate the efficacy, adverse side effects, and long-term results of a random fractional ultrapulsed CO_2 laser on a large population with photodamaged facial skin. Three hundred twelve patients with facial photodamaged skin were enrolled and underwent a single full-face treatment. Six aspects of photodamaged skin were recorded using a 5 point scale at 3, 6, and 24 months after the treatment. The results were compared with a non-parametric statistical test, the Wilcoxon's exact test. Three hundred one patients completed the study. All analyzed features showed a significant statistical improvement 3 months after the procedure. Three months later all features, except for pigmentations, once again showed a significant statistical improvement. Results after 24 months were similar to those assessed 18 months before. No long-term or other serious complications were observed. From the significant number of patients analyzed, long-term results demonstrate not only how fractional ultrapulsed CO_2 resurfacing can achieve good results on photodamaged facial skin but also how these results can be considered stable 2 years after the procedure.

Keywords Fractional laser · CO_2 laser · Photoaging · Wrinkles

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Introduction

The drive to attain cosmetic facial improvement with rapid recovery and minimal risk has galvanized the field of laser skin rejuvenation. Although traditional ablative CO_2 laser resurfacing was widely considered, since its emergence in the marketplace in the mid 1990s, as the gold standard [1–9], the increased risk of prolonged wound healing, infection and pigmentary alteration spurred researchers to look for better options [10–14]. As a result, the market for non-ablative techniques grew fast and many devices claimed to be efficient for wrinkle reduction and photodamaged skin improvement. After a critical review of recent literature, however, it seems clear that none of these non-ablative methods are comparable with ablative skin resurfacing in terms of efficacy [15–18]. In our experience, patients have come to the conclusion that non-ablative approaches simply cannot produce desired results and few of them are willing to accept the long downtime and the high risk of adverse effects for aesthetic reasons. So, on the one hand, ablative CO_2 resurfacing can achieve very good results but, at the same time, put both patients and physicians at risk. On the other hand, non-ablative methods are simply unable to achieve such good results. The question to be asked, then, is how we can offer patients a technique with

low downtime, good effects, and minimal risk of adverse effects at the same time? The answer would seem to lie in fractional lasers. The idea of Manstein et al. [19] was to deliver the energy and leave skin bridges intact between one shot and another. The laser effect is located in the exposed tissue column, while the healing processes start from these intact skin bridges. Through delivery of microscopic, non-contiguous zones of thermal damage using a 1,550 nm, mid-infrared laser source, it was observed that non-exposed epidermal cells and dermal tissue facilitated rapid healing. This technology was highly successful and was quickly followed by a 1,540 nm, 1,440 nm, and mixed 1,320 nm/1,440 nm technologies. Compared to ablative resurfacing, non-ablative fractional resurfacing results in faster recovery and fewer side effects [20]. Although erythema and edema clear up within a few days in most patients, the improvement in rhytids and photodamage is not as impressive as with ablative resurfacing. Mild to moderate improvement is observed, requiring multiple treatment sessions, totalling 5 to 6 and spaced at 1- to 4-week intervals [20].

The concept of fractional delivery of the energy was, therefore, applied to the ablative lasers. The idea was to conjugate the well-known results of ablative lasers while maintaining a short recovery time and a low incidence of adverse side effects.

In recent literature, there are numerous papers that describe the clinical efficacy of several ablative fractional devices, but, as far as we know, the few cases published report only short (less or equal to 3 months) or a medium (from 3 to 6 months) follow-up [38–50].

In August 2006, taking as decision key points, the higher immediate collagen shrinkage and the greater delayed new collagen formation comparing a CO_2 laser versus an Erbium laser [21–30], we decided to buy an ultrapulsed fractional CO_2 laser. The aim of this study is to evaluate efficacy, adverse side effects, and long-term results of a fractional CO_2 laser on a large population with photodamaged facial skin.

Materials and methods

The devices

Laser

The device is a radiofrequency excited ultrapulsed CO_2 laser with a computer pattern generator (CPG) (Ultrapulse Encore, Lumenis Ltd, Santa Clara, CA, USA). CPG settings are described by three numbers: the first indicates the shape pattern (line, hexagon, square, etc.), the second indicates the shape dimension (the higher the number, the higher the dimension) while the third indicates the shots density. The device can now be fitted with two handpieces with various features, but for the aims of this study, only the handpiece with the CPG was used. The handpiece emits spots of 1,300 μm of diameter that can be emitted randomly (a feature known as "Cool Scan" which can be switched on or off by the operator). This reduced diameter allows less heat to build up around each scanned spot, leading to a reduction in post-treatment erythema. With the "Cool Scan" feature, the hits are not laid down adjacent to each other, but are "randomly" placed within the pattern. There is consequently less heat build-up and less thermal injury. This energy emission results in reduced erythema and edema, preventing the so-called "tiger striping effect" due, in the past, to the serpentine pattern. The device always emits shots with a pulse duration between the skin thermal relaxation time [31] and 1,000 μs. This allows us to ablate and to heat the skin, but, at the same time avoid charring [31]. Around each ablation crater, there is a denaturated dermis halo surrounded by a heat "bulla". Using a shot density of 3, the ablation is fractionated but the heat bullae have an overlap of 10 %. This means that we have a fractionated ablation of the surface but uniform heat stimulation of the dermis. With this shot density, the technique should really be called "quasi-fractional" (Fig. 1).

Cameras

A Canon 350D, a Canon 40D, and a Canon 5D MarkII were used, all with an anular flash and/or with an UV anular flash.

Treatment

This study was performed in accordance with the ethical guidelines of the 1975 Declaration of Helsinki. After a 1-h occlusive application of an anesthetic cream (galenic preparation of a Lidocaine 15 %, Prilocaina 5 % in a PEG base), the patients were subjected to the treatment. For those who were

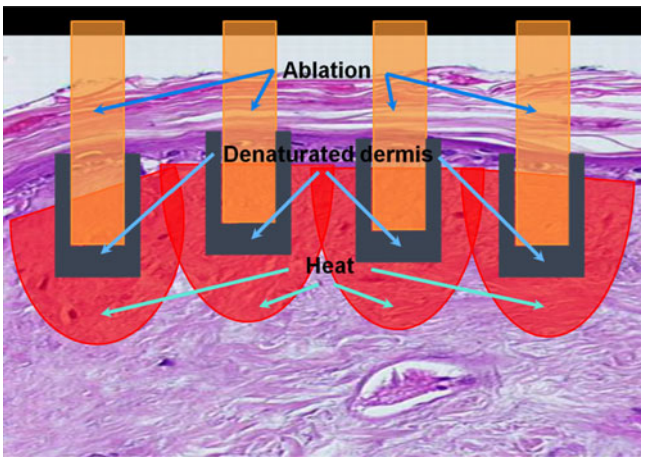

Fig. 1 Fractionated ablation of the surface but a uniform heat stimulation of the dermis. The "quasi fractional" treatment

particularly nervous as well as those with poor compliance (148 patients—49.16 %), 0.7 mg/kg of diazepam drops were administered 30 min before the treatment. The anesthetic cream was first carefully removed and then, alcohol was used to de-grease the skin. After waiting for the complete vaporization of the alcohol previously used, eyes were protected with eye shields. A full-face, single-pass treatment was then performed with no overlapping of the shots. The parameters used were: CPG settings 1-6-3; pulse energy 100–125 mJ; frequency 100–125 Hz. With these parameters, we are using a hexagonal pattern and the ablated skin is about 82 %. The ablation depth is about 110 μm, and the depth of the residual thermal damage reaches 250–280 μm [32].

Instead of reducing the parameters, along the hairline and the jaw-line, the laser handpiece was held at a 45 ° angle to the skin. This results in oval ablation rather than circle ablation, which spreads energy over a larger area and thus blend the treated and non-treated areas. For the eyelids, all parameters were modified as follows: CPG settings: 1-4-1 on the pre-tarsal region, 1-6-3 on pre-orbicular region; fluence, 60–75 mJ; frequency, 75 Hz. We used the Cool Scan and a repetition rate of 0.5 s. The average duration of each treatment was 25 min. Immediately after the shot, there is a distinct stippled gray fractional epidermolysis pattern which allows us to see how the treatment is progressing. The small fine crusts are not removed as they can be used as a completely bio-compatible wound dressing. After a thorough discussion with and consent from the patient, a second pass on the crow's feet or on other deep wrinkles region was performed in order to achieve better results on coarse wrinkles. Immediately after the procedure, wet cold gauzes were applied to the treated surface, kept moist and cool using cold saline solution. Twenty to thirty minutes after the treatment or when the pain or burning sensation eased off, a layer of petrolatum ointment was applied. To evaluate the downtime, healing time was based on the time needed for the crusts to disappear.

Patients

From August 2006 to February 2009, 312 patients (mean age 47.3 years, range 35–73 years) with various grades of photodamaged skin were enrolled in this study. All patients were Caucasian with skin type II or III and gave written informed consent prior to entry. The exclusion criteria were: (1) utilization of any kind of topical treatment (e.g., topical retinoids, azelaic acid creams, topical steroids) in the previous 3 months; (2) surgical aesthetic treatments in the previous 6 months; (3) local injective therapies or other cosmetic procedures (e.g., peelings) in the previous 6 months; (4) other laser or IPL treatments in the previous 12 months; (5) pregnancy; (6) lactation; (7) history of keloids; (8) history of severe herpes infections; (9) likelihood of poor compliance; (10) presence of an active infectious disease or other inflammatory or neoplastic skin diseases; (11) psychiatric diseases; and (12) unrealistic expectations. All patients were clinically and photographically evaluated at baseline (T0), 3 months (T1), 6 months (T2), and 24 months (T3) after the treatment. UV photos were also taken to help the reviewers with evaluations (Fig. 2). A post-treatment follow-up was also performed 1, 3, 5, and 21 days postoperatively, to control the healing progression. Starting the night before the treatment, and in accordance with published guidelines for ablative treatments [33, 34], all patients took oral cefixime 400 mg QD for 5 days, valacyclovir 1,000 mg BID for 14 days, and fluconazole 100 mg QD for 8 days. Cleansing was allowed only with a gentle cleanser (Cetafil detergente; Galderma, Italy) starting from 36 h after the treatment. Before leaving the office, all patients were instructed to repeatedly apply petrolatumoitment for the next 3–5 days and advised against picking or scrubbing the skin. All patients were also strictly instructed to repeatedly apply topical sun-block preparations for 40 days after the treatment. The degree of photoaging and the efficacy of treatment were evaluated using a five-point scale (Table 1) based on the suggestion of Dover et al. [35]. A global score was recorded as well as that of five photodamage variables: fine lines, mottled pigmentation, sallow complexion, tactile roughness, and coarse wrinkles (Table 1). For each patient, the results were separately collected by three of the authors. The choice of these three evaluators has been done within all the authors in a randomized way and excluding the surgeon who previously treated that patient. Clinical scores were then compared using a non-parametric statistical test, the Wilcoxon's test. Results were considered as significant if the p value was < 0.05. All patients gave a pain quantification using a 10-point scale in which 0 was no pain and 9 was intolerable pain. At days 5 and 21, the erythema was quantified using a 5-point scale (0: no erythema, 1: slight erythema, 2: mild erythema, 3:

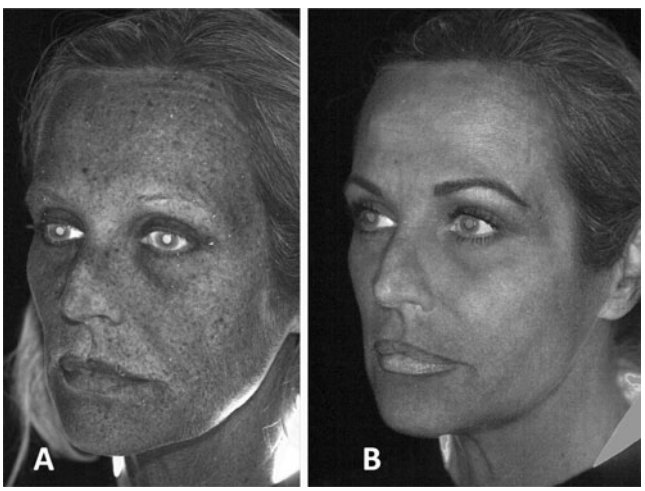

Fig. 2 UV images of a 47-year-old woman before (**a**) and 18 months (**b**) after the treatment

Table 1 Score on a 5-point scale for skin features of photodamage

	0	1	2	3	4
Global score	Facial skin smooth to the touch, without significant fine lines or unevenness in pigmentation in any areas	One area of significant roughness, dyspigmentation (hypo- or hyper-) or fine lines	Two areas of significant roughness, dyspigmentation or fine lines or one area of roughness, dyspigmentation and fine lines	Three area of significant roughness, dyspigmentation or fine lines or two areas of roughness, dyspigmentation and fine lines	Four areas of significant roughness, dyspigmentation or fine lines or three area of roughness, dyspigmentation and fine lines
Fine lines	No evidence	Rare, widely spaced	Several, discrete	Moderate, in close proximity	Many densely packed
Mottled pigmentation	Evenly pigmented skin	Small areas of light hypo- or hyperpigmentation	Small areas of moderate hypo- or hyperpigmentation or moderate areas of light hypo- or hyperpigmentation	Moderate areas of moderate hypo- or hyperpigmentation or small areas of heavy hypo- or hyperpigmentation	Marked hypo- or hyperpigmentation
Sallow complexion	pink skin	Skin is pale	Skin with a slight suggestion of yellowness and greyness	Skin is pale with a moderate suggestion of yellowness and greyness	Skin is pale with a distinct suggestion of yellowness and greyness
Tactile Roughness	skin is smooth	Skin is smooth with occasional rough areas	Mild roughness	Moderate roughness	Severe roughness
Coarse Wrinkles	no evidence	Superficial in one area	Superficial on more than one area or moderate in one	Moderate on more than one area or deep in one	Deep on more than one area

moderate erythema, 4: severe erythema). At T2 (6 months after the procedure), the patients also rated the overall progress on a quartile grading scale from "no improvement" to "excellent improvement" as follows: 0–25 % (no or minimal improvement); 26–50 % (fair improvement); 51–75 % (good improvement); and 76–100 % (excellent improvement). Finally, the patients were asked whether or not they would recommend this treatment to others.

Results

A total of 301 patients completed the study. The mean pain sensation felt during the treatment was 4.1 while the burning sensation felt for 15–25 min after the treatment was 4.5. No patients reported any pain after this 15–25-min period and none took any pain killers afterwards. All patients showed fine crusts (thin, round, yellow/brown, blood-free crusts) in a pixilating pattern fading from the third to the sixth days after the treatment. Only 21 patients suffered from a slight swelling the day after the procedure and, of this number, 7 also had mild oozing for 24 h after the treatment. On day 5, some fine crusts persisted (in all cases near the hair-line and/or in the pre-auricular region) in 45 patients (14.95 %). On day 5, the mean erythema was 2.6, but this went down to 0.7 by day 21. The time between the treatment and the fine crusts fading was considered as "healing time". The mean healing time was 3.9±1.1 days and the erythema lasted for a mean of 13.9±2.1 days. Numerical and statistical results can be appreciated in Table 2. For all of the analyzed variables, the Wilcoxon's test showed a statistical difference between scores at baseline and scores at T1. A statistical difference was also present between T1 and T2 for global score, fine lines, sallowness, tactile roughness, and deep wrinkles but not for the hyperpigmentation. No statistical differences were noted between T3 and T2 but all variables present great improvement between T3 and T0 (Table 2). In 17 patients, we observed that some fine, round hyperpigmentations (mainly in the pre-auricular regions) appeared from 32 to 45 days after the treatment and spontaneously disappeared in all cases after 2–3 weeks. Of note, these patients admitted they had not used proper sun protection after the treatment and all of them are patients who live in the south of Italy where the sun's rays are much stronger than in the north. In another case, the post-treatment erythema lasted 33 days. In seven patients, we noted a prolonged erythema lasting no more than 37 days (mean prolonged erythema 27.3 days). Infections, milia, scars or other adverse side effects were not observed. At T2, 231 patients (76.74 %) noted they would recommend this treatment to others because they had obtained an overall improvement greater than 75 %. Twelve patients (3.98 %) with a similar improvement, however, said they would not recommend the treatment due to the amount of recovery time needed before returning to

Table 2 Statistical significant differences (*$p<0.05$ versus baseline, **$p<0.05$ versus 3 months post treatment) between baseline and 3 and 6 months post-treatment were observed for all features (the improvement noted at 6 months post-procedure persisted 24 months later)

	Baseline T0	3 months T1	6 months T2	24 months T3
Global score	3.65±0.52	2.45±0.41 *	2.07±0.41 **	2.05±0.37
Fine lines	3.40±0.49	2.30±0.43 *	1.87±0.25 **	1.83±0.32
Mottled pigmentations	3.35±0.50	1.35±0.32 *	1.32±0.31	1.28±0.25
Sallowness	3.00±0.58	2.23±0.40 *	1.40±0.39 **	1.37±0.38
Tactile roughness	3.60±0.66	2.22±0.39 *	1.74±0.23 **	1.68±0.26
Coarse wrinkles	3.74±0.48	2.63±0.63 *	2.11±0.23 **	2.20±0.31

normal activities (all these patients were treated at the beginning of our learning curve). Forty-five patients (14.95 %) reporting an overall improvement between 50 % and 75 % said they would recommend this treatment to others, while 13 patients (4.31 %) reporting an overall improvement of between 25 % and 50 % would not recommend the treatment to others.

Discussion

Traditional CO_2 or Erbium resurfacing are well-established methods of treating rhytids and photoaging [20]; however, both the CO_2 and the Erbium:YAG lasers can be associated with prolonged postoperative healing, delayed re-epithelialization, persistent erythema, delayed, and permanent hyper- and hypopigmentation, and the potential for scarring. Even if no adverse side effects do occur, these methods still result in a delayed return to normal activities. Although the ablative effect and its clinical advantage is well described, the exact mechanism by which ablative resurfacing achieves clinical wrinkle reduction is not fully understood. The most attractive theories are based on heat delivery. Both the Erbium:YAG (used in a thermal subablative mode) [36] and the CO_2 laser generate heat. This heat results in an immediate tightening due to shrinkage and denaturation of type I collagen. Fibrillar type I collagen undergoes helix-coil transition, which forcefully shortens the fibers by 30 % [37]. The collagen subsequently undergoes denaturation and acts as a matrix for newly formed collagen [21, 38]. This remodelling involves an initial inflammatory phase characterized by massively high levels of metalloproteinases (MMPs) that degrade the fragmented collagenous matrix followed by substantial and extended production of new undamaged collagen [39]. Despite the excellent results, the higher incidence of adverse effects combined with the prolonged downtime of traditional resurfacing resulted in a loss of interest by both physicians and patients alike. The non-ablative methods then followed, but they have never reached, nor are they ever likely to reach, the same end results as their predecessors, the CO_2 and Erbium-YAG lasers [15–18]. In order to bridge the gap between available results and the demand by both patients and physicians for low downtime and low risks, research led to the development of multiple fractional devices during 2004. These devices create microscopic or tiny columns of thermal injury in the dermis surrounded by islands of healthy tissue, resulting in faster healing processes and minimal risks. By obtaining very good results, the fractional resurfacings have therefore been gaining popularity all over the world. The aim of this study is not to evaluate different ablative or non-ablative fractional technologies but to evaluate if a far infrared random fractional ultrapulsed CO_2 laser can obtain good results on photoaged facial skin with low downtime and with minimal to no risks and to evaluate how these results can remain stable over time . The procedure is fast and simple to perform and covers (with the parameters described) 82 % of the entire surface during each session. The Wilcoxon's exact test results demonstrate that very good improvement can be achieved in fine lines, mottled pigmentation, sallow complexion, tactile roughness, global score and deep wrinkles (only if on them a double passage is performed). The statistical difference between T0 and T1 is probably due to immediate ablative effect and to the immediate shrinkage of the dermis, whereas the statistical difference between T2 and T1 is probably due to new collagen formation. The immediate ablative effect accounts for very good results in mottled pigmentation at T1 and explains why this result is almost the same at T2. At T3 results are very similar to that of T2 and demonstrate how improvements can be considered stable 2 years after the procedure. Statistical results are confirmed by the patients' own evaluation: nearly 90 % of the patients would recommend this treatment to others. In addition, 76.74 % of those patients reported an overall improvement greater than 75 %. All these results can be achieved with a mean healing time of 3.9 days and a mean post-treatment erythema of 13.9 days.

We observed a transitory post-inflammatory hyperpigmentation in just 17 patients (5.64 %), which spontaneously resolved itself in about 2–3 weeks. We ascribed this adverse effect to a discontinuous, incorrect application of the prescribed sun protection. We have no explanation for the seven patients with prolonged erythema, but we noted this adverse effect only on females with very thin skin.

In the last years, a growing number of papers on this subject have been appearing in literature. Starting from the 27th Annual Meeting of the American Society for Laser Medicine and

Fig. 3 A 54-year old lady before (**a**), 6 months (**b**) and 24 months (**c**) after the treatment

Surgery, a lot of papers have so far been published on non-ablative and ablative fractional devices. Practically, all of them report very good results with low downtime and low incidence of adverse side effects. The following overview is limited to the last 2 years and concentrates on some very interesting studies that describe the results of various ablative devices.

Rahman et al. [40] reported, using a CW 30 W fractional CO_2 laser (Reliant Technologies, Mountain View, CA, USA), a moderate to significant improvement in the appearance of rhytids, pigmentation and laxity of the face in more than 75 % of the 30 patients treated. These patients also reported a significant transient post-treatment erythema which resolved itself within 3 months. Again, Rahman et al. in 2009 [41] reported, using the same device at settings of ≤20 mJ/pulse and 400 MTZs per pass, a moderate or better improvement of skin texture, appearance of wrinkles, laxity, and appearance of pigmentation in more than 67 % of patients 3 months after the procedure. However, the same paper also reported the presence 1 month after the procedure of erythema in 33 % of patients, of edema in 10 % and of hyperpigmentations in 20 %. Weiss et al. [42], using the same device as the one used in this study, reported an average improvement in rhytids of 50–75 %, 3 months after the procedure. They also reported minimal pain and a post-treatment erythema varying from 4 to 6 days. At the end of 2007 [43], one of the authors (MTC) of this study published a preliminary clinical report on the use of the same device used in this study. He reported a statistical significant improvement 3 months after the procedure of more than 75 % of five skin features in 75.47 % of 55 patients. He reported an average healing time of 3.3 days and an average erythema time of 13.6 days. Only one transitory hyperpigmentation (spontaneously resolved) was described. In February 2009 [44], a very interesting clinical and histopathologic evaluation on this kind of device was published by Berlin et. al. They reported an average reduction of the elastosis, 6 months after the procedure, of 1.5 in a 5-point scale. They also reported an average reduction, at the same follow-up consultation, of wrinkles and texture of 1.6, again in a 5-point scale. Using a 5-point satisfaction scale, they reported an average patient satisfaction

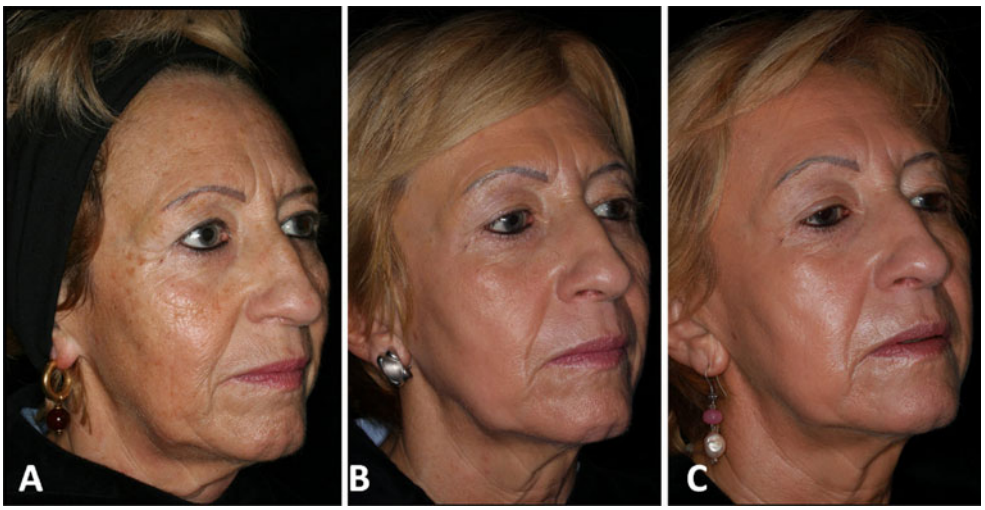

Fig. 4 57-year-old woman before (**a**), 6 months (**b**) and 24 months (**c**) after the treatment

of 2.5. In the same paper, it was demonstrated that there is more fibrosis in papillary dermis after the procedure than before. Additionally, electron microscopy revealed a decrease in the average diameter of the collagen fibrils, consistent with greater deposition of collagen type III, 1 month before Salujia et al. described the clinical and histological effects of the same device. They demonstrated on 15 patients how, by increasing the shots density, the erythema and edema time will increase. They also demonstrated how an increase in density increased the depth of penetration while an increase in power increased the width of basophilic coagulation. In a study conducted on 32 subjects, Levy et al. [46] reported systematic wrinkle reduction 6 months after the procedure using a fractional CO_2 laser (Quanta Medical, France) delivering a pattern of 300 μm spots spaced 2,400 μm apart. Using various energies (120–240 mJ), they histologically demonstrated restored epithelium in 5 days, dermal fibrosis of 200–550 mm around the cones of altered collagen and neo-collagenesis at 30 days. Dierickx et al. reported in 2008 [47] the results on perioral and periorbital regions of 13 patients (108 regions treated) using a 2,940- and a 2,790-nm fractional laser (Palomar Medical, Burlington, MA, USA). They reported a 3-month improvement of 2 (statistically significant) on a 10-point wrinkle scale in 42 % of periorbital treated regions and 50 % of perioral treated regions. They also reported the presence of mild erythema in more than 16 % of patients 3 months after the procedure using the 2,940 nm handpiece and the same effect in 50 % of patients using the 2,790 nm. Trelles et al. reported in 2009 [48] their results on 30 women treated with a 2,940 nm fractional laser (Harmony platform, Alma laser, Israel) for facial wrinkles. At the 2-month follow-up, 23.33 % of patients were reported as having an improvement greater than 75 %. Again, in 2009, Gotkin et al. [49] described their results on 32 patients using a CO_2 fractional device (Smartxide DOT, DEKA, Italy). They treated patients for rhytids, lentigo and solar elastosis, acne scars, and striae. The average improvement 6 months after the procedure was 3.47 in a quartile scale where 0 was no improvement and 4 was an improvement greater than 75 %. This mean improvement was higher 1 month after the procedure (3.69) than the final result (3.47). They also reported the presence, 1 month after treatment, of edema in 46.87 % of patients and of PIH in 40.62 % of patients. Finally, in May 2009, a comparative study (eight different devices) was published by Waibel et al. [50]. Eighteen patients underwent one ablative fractional treatment for mild-to-severe photodamage and rhytids. Although the limited number of subjects did not allow for statistical confirmation of relative efficacy, it appears that analyzed CO_2 lasers delivered superior efficacy for rhytids with respect to analyzed Er-YAG lasers. In a standard quartile scale (from 0 to 4), CO_2 lasers determined a mean improvement of 2.05±0.20, while Er-YAG lasers determined a mean improvement of 1.50±0. Mean CO_2 downtime was additionally lower than mean Er-YAG one.

Conclusions

Good results on skin type I–III photodamaged facial skin can be obtained by using a random fractional ultrapulsed CO_2 laser (Fig. 3). The high number of patients analyzed and the long-term follow-up demonstrate not only how this technique can achieve very good results but also how these results can be considered stable 2 years after the procedure (Figs. 3 and 4). In addition, the technique has a short downtime and a very low incidence of what are only transitory adverse effects. This data thereby allows us to affirm that fractional ultrapulsed CO_2 resurfacing can be considered a tried-and-tested technique to treat photoaged facial skin. If the parameters are modified, results can also be changed. Very low fluence and density of the shots only allow for a refreshening of the skin but with a very short downtime. Increasing the settings (fluence, density of shots, and number of passages), we will get nice results (such as a traditional skin resurfacing), but we will also have a longer downtime. In conclusion, we now have the right tool for those numerous patients requiring more than non-ablative treatment who are unwilling to accept a long downtime.

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