

DISCUSSION

Ablative Fractional rejuvenation has become increasingly popular for patients with photodamaged skin who desire effective treatment with minimal postoperative recovery. Before the emergence of fractionated technology, the primary laser modality used for facial resurfacing was ablative laser devices (CO₂ and Er:YAG), which were associated with significant side effects of prolonged edema, erythema, crusting and hyperpigmentation, with potential long-term risks of permanent dyspigmentation and scarring and other textural abnormalities.⁽²⁶⁶⁾ The pixilated pattern of wounding in FP, in which non-ablated tissue surrounds columns of thermal damage, promotes faster re-epithelialization and greater tissue contraction and tightening with minimal recovery time and minimal to no risk of long-term post-inflammatory change or scarring.^(106, 267)

The present prospective study, is about the effectiveness of fractional ablative CO₂ laser in the treatment of photoaged skin. Patients were selected from the dermatology outpatient clinic of the main University Hospital, Faculty of Medicine, University of Alexandria. The study sample was 50 female patients. This might be because females care a lot about their cosmetic appearance and eager to try any new cosmetic treatment. The gender-specific incidence of photoaging depends on the structural and functional skin features and exposure to hormonal and environmental factors. There is no study giving a meaningful comparative results regarding, gender-specific incidence of photoaging.⁽²⁶⁸⁾ Fitzpatrick phototypes of patients were II-IV, this is in agreement with the literature⁽²²⁾ that individuals of all skin phototypes can manifest photoaging, but in different clinical features. Patients' mean age was 46.4±8.79 (29-64). This in agreement with literature in that facial aging starts from the third decade onwards.⁽¹⁰⁾

Each patient received 3 sessions with a 10,600nm prototype CO₂ medical laser system(ATL-250)⁽²⁶²⁾ built by Advanced Technology Laser Company ,Ltd, Shanghai, China. The device is equipped with a scanner, which allows ablation of small holes in skin at (100µs-10ms) pulse width and adjustable scanning size and pattern and array density. In the study, the scanning mode was used. Treatment parameters were set as follows: power was 4-6 W, PPI (array density) was 4 and time was 3-4 ms, one pass only was applied to the treated area per session. The shape of scanning area was set to 9x9 rectangle.

Patient satisfaction was assessed according to a 4 points scoring system (1= poor, 2=good, 3= very good and 4= excellent). 20 % of patients were not satisfied. The other 80% of patients had mild and moderate satisfaction rates regarding improvement of their photoaging. No patient showed excellent satisfaction rate.

Assessment of improvement Glogau's classification of photoaging^(25,26) and Fitzpatrick wrinkle score⁽²⁴⁾ showed non-significant improvement. Comprehensive grading scale wrinkle score was significantly improved while other scores showed non-significant changes. Assessment of improvement using Coscam photographing before each session and the end of three months follow up period was done. When results between each two successive sessions were compared, there was statistically significant improvement in pore size and pigments before 3rd session. No statistically significant improvement observed in wrinkles was observed. follow up photos showed insignificant improvement in all parameters.

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On the other hand, comparing results from each session with baseline showed that there was statistically significant improvement in pore size and pigments after 2nd session and during follow up. No statistically significant improvement in wrinkles was observed.

All the methods used to assess improvement was using different grading scales and scoring, this might be the cause for discrepancy in results between different scales and methods.

Many clinical studies on fractional ablative CO₂ laser rejuvenation were performed. A Study on 45 Patients (Thirty-nine women and six men) was done by Tierney and Hanke⁽²⁶⁹⁾, in which treatment was administered using SmartXide Dermal Optical Thermolysis (DOT, DEKA, Calenzano, Italy), an ablative fractionated CO₂ laser (10,600 nm) at settings of 30W and 500 μ m pitch for 1,000 to 1,500 μ s. Patients mean age was 58.5 years and of Fitzpatrick skin type I-III (26.7% Fitzpatrick skin type I, 60.0% Fitzpatrick skin type II, and 13.3% Fitzpatrick skin type III). Patients received a series of two to three treatment sessions at 8-week intervals. The degree of clinical improvement with treatment determined the number of treatment sessions. Six months after the final treatment, physician evaluation of photographs was done to assess the degree of improvement in four clinical indicators: skin texture, skin laxity, individual rhytides and overall cosmetic outcome. Each of the clinical indicators was evaluated on a quantitative photoaging scale based on the scale designed by Alexiades-Armenakas⁽²³⁾ and modified by the researchers to apply to changes in photoaging after AFR. When photos before first session was compared with as follow: the mean score decreased from 3.3 to 1.7 for skin texture (48.5% mean improvement), from 3.0 to 1.5 (50.3% mean improvement) for skin laxity, from 3.2 to 1.5 (53.9% mean improvement) for dyschromia and from 3.6 to 1.2 (52.4% mean improvement) for overall cosmetic outcome (all p0.05).

Tierney and Hanke study was conducted on fair skinned patients .Those patients are less exposed to laser complications specially PIH even with high parameters. Also, photoaging clinical features are strongly influenced by phototype⁽²²⁾ and the use of laser on different clinical phenotypes will lead to different responses.

Neaman et al,⁽²⁵²⁾ used fractional ultrapulse CO₂ laser (Ultrapulse Encore, Active FX, Lumenis Ltd., Santa Clara, CA) in their retrospective review of 97 treated patients. The average patient age was 53 years (range, 17-76).Ninety-five percent of patients were female. The average length of follow-up was four months (range, two weeks to 19 months). A majority of patients had undergone previous surgical and nonsurgical treatments. For local anesthesia they started with topical anesthetic cream then sensory nerve blocks were performed. The laser settings were determined according to treated area and problem areas received a double and/or triple pass, as dictated by the surgeon. When multiple passes were performed, the epidermis was debrided with a tongue blade between each pass. Energy used was 70-150mJ and density 3-6 and frequency was 75 -500Hz. Fitzpatrick Skin Type for the patients were I-IV and one patient was type V(90 patients were skin type II-IV). 97% of patients were Caucasian, 3% were Asian. Four patients went on to receive additional laser treatments during the study period because of the severity of their underlying rhytids. Patient satisfaction scored on five points scale with five being the highest. 66.6% of the patients gave score 4 and 5.

Although the Neaman's study was done on 90 patients with phototypes I-V,the majority of patients had undergone previous surgical and nonsurgical treatments, so the

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study results don't reflect the pure effect of fractional laser. In the present study, patients with history of any cosmetic intervention at the area to be treated or used isotretinoin within the previous 12 months, are excluded. Also, there is no objective scale in the study to assess the real effect of fractional laser.

Chan et al. ⁽²⁷⁰⁾ conducted a study on nine Chinese patients (five males and four females). Patients underwent one full-face treatment with the 10,600nm fractional CO₂ laser (Fraxel Re:pair, Solta Medical, Hayward, CA). Four patients were treated for skin rejuvenation with the remaining five for acne scars. Fitzpatrick skin types of patients III and IV, mean age 44.8. The energy levels ranged from 30– 70mJ with coverage between 30% and 45% and number of passes is 4. Improvements in skin texture, laxity, wrinkles, enlarged pores and overall pigmentation irregularity were assessed up to 6 months post-treatment were all statistically significant.

Objective assessment using standardized photographs by the Canfield Visia CR system1 that were assessed by two independent observers was done. This assessment revealed that the degree of improvement in skin texture, skin laxity, wrinkles, enlarged pores and acne scars at 1 month post-treatment in most of the cases were graded as mild but 33.4% of the cases experienced worsening in overall pigmentation irregularity. At 3 months 87.5% or more of patients in skin texture, skin laxity, wrinkles and enlarged pores, were graded as mild to moderate. Only 25% of patients had improvement in the overall pigmentation irregularity, which was graded as moderate. 12.5% of patients had worsening in overall pigmentation irregularity. At 6 months post-treatment, the degree of improvement was maintained and similar to that at 3 months.

Subjective assessment with patient questionnaires showed that at 3 months post-treatment, 42.8% of patients reported mild, moderate to excellent improvement in wrinkles. 28.6% of patients sustained this improvement at 6 months. As for pore size, 57.1% and 42.9% of patients noted mild, moderate to excellent improvement at 3 and 6 months, respectively.

Sample size in Chan's study is very small and cannot be generalized. It is also noted that the objective analysis showed improvement of 87.5% of patients but only about half of them felt the improvement. The camera used in the present study is less accurate than the one used in Chan's study because it is operator dependent, this may be another cause of discrepancy in results. Worsening of overall pigmentation in Chan's study-which didn't occur in the present study- may be explained by higher number of passes that he used.

Chan in his study used before the laser session 5% lidocaine cream, Two tablets of dologesic (acetaminophen with dextropropoxyphene hydrochloride) and diazepam 5mg and 25–50mg pethidine and with 10mg metoclopramide were administered intramuscularly for additional analgesia. The number of passes may explain this huge amount of anesthesia.

Seven subjects (4 women and 3 men, ages 47.0±15.6 years) with skin types IV and V) with photodamaged skin were enrolled in the study by Kee Lee Tan et al ⁽²⁷¹⁾ Each subject received a single facial treatment with a fractional CO₂ laser. The treatment procedure followed a specific protocol (ActiveFX™) for superficial resurfacing with (UltraPulse® Encore™; Lumenis Inc, Santa Clara, CA). Topical anaesthetic cream was used 1 hour before treatment. Treatment settings were 60 mJ energy and density 1. At a

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density setting of 1, approximately 60% of the facial skin surface was ablated. Treatment consisted of a single pass without cooling. Subjects returned on alternate days for 14 days and at 1 month, 3 months and 6 months after treatment for evaluation of improvement and PIH. Subjects agreed to avoid sun exposure for 3 months, remain indoors for 7 days, wash their faces with normal saline and apply petroleum jelly twice each day for 3 days after treatment, hydroquinone 4% in the mornings, tretinoin 0.05% (Retin-A®) in the evenings of days 3 through 14 and sunblock (SPF 30+) from day 14 to 3 months after treatment. Subjects were photographed (3.2 megapixel digital camera DSC-505V, Sony, Tokyo, Japan) before, immediately after treatment, and on days 2, 4, 8, 15, 30 and 40 after treatment. All subjects achieved subjective improvement in their specific skin condition and in skin texture.

Sample size in Kee Lee Tan's study also is very small and results can't be generalized. The post laser regimen is very aggressive and it even led to hypopigmentation in one patient, so it is not used in the present study. It is also, not practical to tell patients to avoid sun for 3 months.

It is noted that researchers in the previous four studies used different devices with different technical specifications (appendix), so parameters cannot be generalized. Another point worth noting is that there is still no true consensus scale for photoaging improvement evaluation, which is reflected by the lack of standardization in assessment as seen in different clinical studies. So, results in the study couldn't be compared with other studies' results.

Immediate post laser side effects (erythema, oedema) were mild in most of the patients and last for 2 days maximum, complete re-epithelization occur within 10 days.

One of the main concerns in the treatment of darker skin colors with ablative lasers is the development of pigmentary Alterations. In the present study, the PIH rate after 150 sessions was 8%, most of which was transient and treated with retinoid. no patient developed hypopigmentation.

The other side effects observed, were inflammation, erythema, anesthetic hypersensitivity. Inflammation, which was observed in 5.3% of patients and was transient. Only 1.3% of patients had residual mild erythema on cheeks. 1.3% of patients showed hypersensitivity to Pridocain™ before her third session.

In the study conducted by Chan et al, ⁽²⁷⁰⁾ all patients experienced erythema within the first 7 days post-treatment, which persisted up to 1 month decreased in severity. Two patients (22.2%) had residual mild erythema at 6 months. Edema was also seen in all patients within 7 days post-treatment, 33.3% of which had resolved by 1 month. No persistent edema was seen at 3 months or beyond. Pin-point bleeding was observed in 86% of patients, all of which resolved within the first week. 71.4% and 100% of patients experienced oozing and crusting, respectively, on day 1, which all subsided by day 7. There was one case of mild focal bruising in the lower eyelids, which persisted for less than a week. The post-inflammatory hyperpigmentation (PIH) rate at 1 month post-treatment was 55.5%. The majority of these cases were considered as moderate in severity. By 3 months, the PIH rate decreased to 37.5%, with most cases being graded as mild. At 6 months, only one patient (11.1%) had persistent PIH. No hypo-pigmentation, blister,

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erosion, scarring, acneiform eruption, facial dermatitis, bacterial or viral infection was seen at the any of the follow-up visits of up to 6 months post- treatment.

The present study shows a broad agreement with Chan's study regarding the type of complication due to the similarities in skin phototypes. On the other hand ,Prolonged complications and immediate post-laser pin point bleeding may be due to the large number of passes.

Neaman et al,⁽²⁵²⁾ reported in their study that ninety- three percent of patients had less than five weeks of post-treatment erythema. One patient had more than eight weeks of erythema secondary to a contact dermatitis. Post-treatment complications were minor and included transient hyperpigmentation, milia and acne .They reported that patients with hyperpigmentation tended to be those who were noncompliant with the post-treatment skin regimen, failing to apply sun block with early sun exposure. Hyperpigmentation generally occurred three to four weeks post-treatment and lasted, on average, 5.7 weeks (range, two to 12). The laser settings for these patients were not significantly different from those of other patients, but the skin types were statistically higher (III-V). All cases resolved with application of hydroquinone. One patient with a history of multiple lower lid blepharoplasties did experience a transient ectropion. Her ectropion did not result in any exposure keratitis and was edema related. It resolved after four weeks of treatment with eye lubricants and gentle massage. The following post-treatment complaints were recorded: intraoperative pain, pigmentary changes, visible patterns, length of recovery time, ocular irritation and acne outbreak. All of these reported complications were transient in nature. No patients experienced post-treatment hypopigmentation or herpes outbreaks.

The present study is in a great agreement with neaman's study, except for acne and ectropion which didn't happened in the present study

In Tierney and Hanke⁽²⁶⁹⁾ study there was no incidence of adverse events of scarring, prolonged erythema (lasting more than 7 days), post-inflammatory hyper- or hypopigmentation, or infection in all treatment sessions given during that study. This might be because the patient phenotypes were from I-III, and lighter skin colours are vulnerable to erythema as post-fractional laser complication. Hunzeker et al,⁽²⁷²⁾from their experience with more than 2000 treatments with fractionated CO₂ laser for different indications noticed that erythema persist in fair skinned and after aggressive treatment.

In the present study, no patient reported scar as a complication. Affected areas in the eye lids are not treated. Patients with keloid history are excluded. Avram et al⁽²²⁸⁾ reported in his case series; five cases of post-AFR hypertrophic scarring that probably resulted from long pulse durations and high levels of treatment coverage.⁽²²⁸⁾ These reports highlight the importance of treating with conservative fluences and pulse duration with AFR, particularly for the neck, where less density of pilosebaceous units can lead to prolonged times for reepithelialization and greater risk of scarring with all forms of ablative laser resurfacing.

In their case series, Fife et al⁽²²⁶⁾also described four cases of post-AFR scarring, including one case in which the patient developed erosions and swelling of the right lower eyelid 2 days postoperatively that developed into scarring and an ectropion.

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In Kee Lee Tan et al ⁽²⁷¹⁾ study ,treatment-induced hyperpigmentation was not observed in any subject. Mild hypopigmentation that appeared on day 15 in 1 subject was attributed to the prophylactic use of tretinoin and hydroquinone. Hypopigmentation improved when medications were discontinued. This study provides subjective evidence to lower risk of PIH in darker skin time after AFR.

In summary, the present study showed that fractional ablative CO2 laser resurfacing was minimally to moderately effective but safe for skin rejuvenation in skin types II-IV.. Appropriate patient selection is important to achieve good results and avoid complications. Further studies with higher number of passes longer follow up would be useful to determine the optimal treatment approach of fractional ablative CO2 laser treatment .

SUMMARY

- Cutaneous aging is a complex biological phenomenon in which two independent processes affecting the skin simultaneously. The first process is the intrinsic aging, while the second process is the extrinsic aging, which is the result of exposure to outdoor elements, primarily UV irradiation. They can be distinguished clinically and histologically.
- In contrast to old photo-protected skin, which is smooth and clearly does not develop sagging appearance, Photoaged skin usually shows a variety of clinical manifestations, including coarseness, wrinkling, sallow discoloration, telangiectasia, irregular pigmentation and a variety of benign, premalignant and malignant neoplasms.
- Dermal elastosis is the histological hallmark of photoaging.
- Photoprotection of the skin is directly related to the thickness of stratum corneum and the degree of pigmentation.
- Natural ingredients from Plants and plant extracts were used to treat photoaging manifestations. Yet, there is a constant need for more clinical studies to evaluate these products.
- Familiarity with Fitzpatrick phototype classification of skin types is important when evaluating an aging face to choose the right treatment and evaluate anticipated risks.
- Therapies for the treatment of photodamage can be subdivided into primary, secondary and tertiary treatment/prevention. Primary prevention, in the form of photoprotection, will reduce development of extrinsic aging. Secondary treatment/prevention, in the form of topical retinoid therapy, aids in attenuating the effects of photoaging. Lastly, tertiary treatment/prevention ameliorates the effects of photoaging as well as intrinsic aging via the use of botulinum toxin, soft tissue fillers and superficial chemical and laser skin resurfacing.
- The CO₂ laser beam is in the infrared spectrum of 10 600 nm
- Fractional CO₂ laser is largely used for cosmetic indications, principally acne scarring and wrinkles. Their use in non-cosmetic dermatology indications has not been fully explored.

Fractional laser skin resurfacing complications can be classified according to severity in to mild, moderate, severe complications.

- Pigmentary Alterations is considered the main concern in dark skin colors.
- Practitioner and patient must follow fractional co₂ laser guidelines regarding patient selection, preoperative assessment and postoperative care to avoid complications
- In the present study, the study sample was 50 female patients (Fitzpatrick phototype II-IV) complaining from symptoms of photoaging .Patients were selected from the dermatology outpatient clinic of the main University Hospital, Faculty of Medicine, University of Alexandria. Patients' mean age was 46.4±8.79 (29-64). 44% of the patients were not working, while 56% were working. each patient was exposed to 3 sessions with a 10,600nm prototype CO₂ medical laser system(ATL-250)built by Advanced Technology Laser Company ,Ltd Parameters used were as follows : power was 4-6 W ,PPI(array density) was 4 ,and time was 3-4 ms ,one pass only. The shape of scanning area was set to 9x9 rectangles.

Summary

- In view of the improvement observed in our study after a three treatments, there is a need to review the current role of fractional ablative CO₂ laser treatment as compared to other modalities for skin rejuvenation in phototypes II-IV.
- Regarding the risk of post inflammatory hyperpigmentation and other side effects, CO₂ fractional laser is considered safe in phototypes II-IV.
- Further studies with a larger group of patients and longer follow up would be useful to determine the optimal treatment approach of fractional ablative CO₂ laser treatment in phototypes II-IV.
- An objective scale for evaluation of photoaging improvement, need to be set.
- Combination of Fractional CO₂ laser with other modalities is recommended in treatment of photoaging

CONCLUSION

- Photoaging is an accelerated aging result mainly from excess exposure to UV irradiation.
- Photoaging clinical phenotype differs in different phototypes, So ablative fractional rejuvenation shows different results
- Fractional CO₂ laser is used to resurface the skin and improve textural changes caused by photoaging.
- In view of the improvement observed in our study after a three treatments, there is a need to review the current role of fractional ablative CO₂ laser treatment as compared to other modalities for skin rejuvenation in phototypes II-IV.
- Regarding the risk of post inflammatory hyperpigmentation and other side effects, CO₂ fractional laser is considered safe in skin colors from II-IV.