

ORIGINAL RESEARCH REPORT

## Treatment of acne scarring with fractional CO<sub>2</sub> laser

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### Abstract

**Background:** Fractional ablative CO<sub>2</sub> laser therapy is based on the theory of fractional photothermolysis. It can be effective in treating acne scars in a less invasive fashion than conventional ablative CO<sub>2</sub> laser therapy. **Objective:** In this clinical study, the safety and efficacy of a novel CO<sub>2</sub> fractional ablative laser was investigated for the treatment of facial atrophic acne scarring in Chinese individuals. **Materials and methods:** A total of 31 patients (11 females, 20 males, Fitzpatrick skin phototypes III–IV) with facial acne scarring received three sequential fractional treatments over a 6-month period. Outcome measurements included blinded evaluations of before and after photographs by two physicians at 3 and 12 months after the final treatment. Global improvement was noted as well as any untoward events. **Results:** At the 12 months follow-up time period, 12.9% of the patients showed excellent improvement in their acne scars, while 38.71% noted good to fair results. The clinical response at the 12-month follow-up visit tended to be better than at the 3-month follow-up visit, but was not statistically significant. Four patients experienced post-treatment and transient PIH but three patients were noted to have prolonged erythema. There was no evidence hypopigmentation or worsening of the scarring in any of the study patients. **Conclusion:** This high-energy pulsed and cool-scanned fractional ablative CO<sub>2</sub> laser system is safe and effective for facial atrophic acne scarring. Improvement in scarring was noted in the majority of patients with minimal discomfort and minimal downtime. Continued improvement over time is also an important clinical finding.

**Key Words:** fractional photothermolysis, CO<sub>2</sub> laser, acne scarring, treatment

### Introduction

Acne is a very common disease affecting a large portion of the population. It is caused and precipitated by many factors including: the proliferation of *Propionibacterium acne* bacteria; an increased sebum production; androgenic stimulation; follicular hypercornification; as well as an infiltration of lymphocytes, macrophages and neutrophils, with cytokine activation. Despite appropriate and effective acne treatment available to our patients, reports of scarring in various degrees occur in approximately 95% of all who suffer from acne (1).

Effective treatment of facial atrophic acne scarring remains a great challenge. Different therapeutic

modalities have been used over the years including chemical peels, surgical excision, punch grafting, dermabrasion and injection of fillers, all with varied outcomes (1,2). Factors described for these varied outcomes include incomplete scar removal, poor intraoperative visualization, and transmission of infectious debris, scar worsening, tissue fibrosis and permanent pigmentary alteration. (2–4). Ablative CO<sub>2</sub> laser skin resurfacing, which is based on the principle of selective photothermolysis, can effectively improve facial atrophic acne scarring, but has been hindered in its continued use by an extended post-operative recovery period and associated morbidity (4,5). Post-treatment CO<sub>2</sub> ablative adverse

events in Asian patients including hyperpigmentation, prolonged erythema and a worsening of the scars also hinder the application of this technique in darker-skinned individuals.

A novel high-energy pulsed and cool-scanned fractional CO<sub>2</sub> laser following the theory of fractional photothermolysis (FP) has been introduced and is available in China. This laser has been shown to decrease the CO<sub>2</sub> laser-induced adverse events and has been shown to enhance wound healing as compared to traditional CO<sub>2</sub> laser ablative resurfacing (5,6). The purpose of the present study is to evaluate the safety and efficacy of this novel fractional ablative CO<sub>2</sub> laser in treating facial atrophic acne scars in Chinese individuals.

### Materials and methods

Thirty-one Chinese patients were enrolled into this clinical trial and each received three sequential fractional ablative CO<sub>2</sub> laser treatments (ActiveFx, Ultrapulse 5000, Lumenis, USA) at 2-month intervals at the Department of Dermatology, Huashan Hospital, Fudan University in Shanghai, China from May, 2007 to March, 2009. The laser settings were as follows: fluence 150–200 mJ, microthermal treatment zone density level of 5–6, spot size 1.2-mm, pulse rate 30–50 Hz, each patient received one pass per treatment area. The coolscan mode was used to generate microthermal treatment zones (MTZ) in a randomized fashion to avoid overheating of the treated skin. Eight patients had their whole face treated; nine patients had their cheeks and forehead treated and 14 individuals had only their cheeks treated. Topical anaesthesia (2.5% lidocaine cream) was applied to 21 patients for 1 hour prior to the laser treatment to alleviate pain prior to the laser therapy. Seven patients had received IPL treatment before enrolment in this clinical trial, all with poor responses noted in improving their acne scars.

Exclusion criteria included photosensitivity, pregnancy, history of keloidal formation, history of autoimmune diseases, recurrent facial infection, ongoing active facial acne, intense sunshine exposure, retinoid use within 1 month before enrolment in the study and history of laser skin resurfacing, chemical peeling or dermabrasion within the previous half a year. The therapeutic protocol was explained to each patient with written informed consent obtained before the laser treatment.

All of the patients were provided with a gentle non-alcohol-based cleanser to remove all the makeup or debris before each procedure. Post-operatively, the treated areas were covered with an antibiotic ointment and the patients were informed to avoid sun exposure for at least 1 month. Photographs were taken at each assessment with a high-resolution digital camera (EOS 400D, Canon, Japan) with

constant lighting and environment for objective evaluations, which were performed by two blinded independent dermatologists at months 3 and 12 after the final treatment.

As an outcome measure, global assessments of the patients' percentage of improvement were made based on the following four-point scale: poor improvement (<25%), fair improvement (26–50%), good improvement (51–75%) or excellent improvement (76–100%). Patients were also assessed for adverse events, such as textural and pigmentary alterations at each of the follow-up visits. Statistical analysis was performed with Chi-square test at the significant level of 0.05 using SPSS13.0 software.

### Results

Thirty-one Chinese patients (11 females, 20 males; aged 16–28, mean 22.0 years; Fitzpatrick skin phototypes III–IV) with mild (superficial rolling) to severe (deep ice-pick and boxcar) atrophic facial acne scarring received three sequential fractional ablative CO<sub>2</sub> laser treatments with the novel laser system.

Immediately following each treatment, a mild, diffuse facial erythema with edema was noted in the treatment area, which was noted to last between 24 and 48 hours in the majority of the patients. During the laser procedure and for up to 1 hour after the laser resurfacing, many patients (especially those with large areas being treated) experienced a moderate to severe stinging sensation none of which affected treatment outcomes. Three patients experienced mild bleeding post-operatively for 1–2 days before crusting was seen. Complete wound healing was evident between 5 and 13 days (with a mean of 7 days). Four patients exhibited post-treatment and transient PIH and three patients had prolonged erythema, with both noted to disappear within 2–5 months without any additional interventions. Those with PIH and prolonged erythema were patients treated with higher laser fluencies and densities. There was no evidence of hypopigmentation, infection or scar worsening in any patients after their laser-treatments. As far as the shape and depth of the acne scars, the more superficial atrophic scars showed better results than deeper ones in our study (Figure 1).

The clinical response of the patients enrolled in this patient is summarized in Table I. Three months after three laser treatments, an excellent response was observed in 2 (6.5%) patients, a good response in 9 (29.0%), a fair response in 11 (35.5%) and a poor response in 9 (29.0%), respectively. At the 12-month follow-up time period, the number of patients with excellent, good, fair and poor improvements in acne scars were 4 (12.9%), 8 (25.8%), 13 (41.9%) and 6 (19.4%), respectively

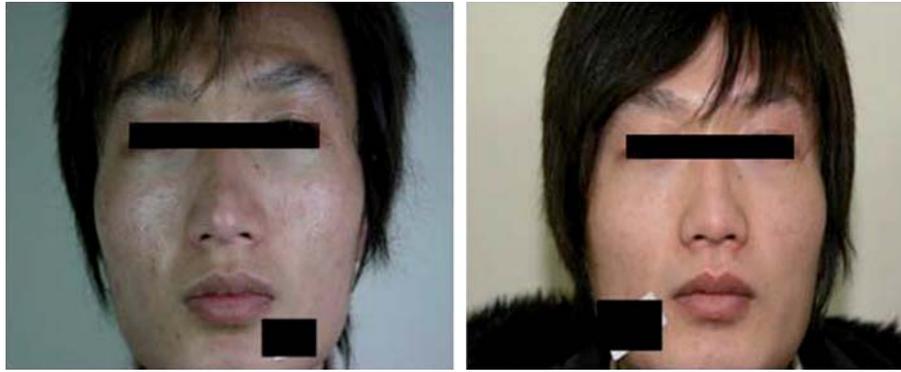


Figure 1. A 19-year-old man with atrophic scarring before (left) and after his 3rd CO<sub>2</sub> laser resurfacing (right). Improvement of the depressed scarring is noted.

(Table I). It appeared there was more improvement at the 12-month follow-up time period than at the 3-month follow-up, although there was no statistical difference observed ( $\chi^2 = 1.514$ ,  $p = 0.652$ ). Four of the seven individuals who had accepted IPL treatment were effectively improved.

### Discussion

Acne scars vary in morphology and in depth, range from superficial rolling atrophic scars to deep ice-pick and boxcar lesions, extending into the deep reticular dermis and even the subcutis, with psychological problems often following in many (4). Most patients, especially the young, were eager to receive treatment to remove their acne scars removed. The major drawbacks with many of the therapeutic options used in the past include prolonged downtime and many potential adverse events. Because of these adverse effects, such as permanent pigmentary alternations, prolonged erythema<sup>\*\*\*\*\*</sup> and a worsening of acne scars, the ablative CO<sub>2</sub> laser skin resurfacing as a long-term and classic collagen remoulding option is not a viable option for those with darker skin types.

Introduced in 2003 (6), fractional photothermolysis (FP) is a relatively new concept of skin rejuvenation. By means of FP resurfacing, discrete columns of thermal damage, referred to as microthermal

treatment zones (MTZs) were generated at specific depths in dermis. FP characteristically spares the tissue surrounding each column resulting in faster re-epithelization than traditional CO<sub>2</sub> ablation and thereby improves wound healing (5–9). Owing to the potent thermal effect of CO<sub>2</sub> ablative lasers, fractional CO<sub>2</sub> lasers can retain most of the powerful collagen remodelling capacity of traditional CO<sub>2</sub> laser resurfacing, while significantly decreasing the adverse effects at the same time, especially with the coolscan mode, which causes less heat accumulation in the dermis. After utilizing this device in clinical practice for approximately 5 years, the coolscan-mode fractional CO<sub>2</sub> laser has now been used to study to atrophic acne scars in Chinese individuals to evaluate its safety and efficacy in this patient population.

In our study, atrophic acne scarring patients received three laser treatments. We observed that the majority of Chinese patients had excellent to fair improvement in their acne scarring. There appeared to be more improvement in the clinical response at 12 months after the treatments than that at 3 months after the treatments, although there was no statistical difference noted probably due to the small sample size in our study; therefore a further study with a larger sample size is necessary. The majority of the 19.35% patients with a poor clinical outcome had deep ice-pick scars which were usually the result of a more severe inflammatory acne course, and this is still a challenge for fractional CO<sub>2</sub> laser therapy.

Post-treatment adverse events were mild to moderate according to our investigation. PIH and prolonged erythema were the most common, depending on the setting we used and the skin type of patients being studied. The higher the energy and MTZ density, the longer the time required for healing. According to Chan et al. (10), density might be of more importance in determining the risk of PIH after 1540 nm fractional laser therapy in darker skin types. Therefore, it may be reasonable to increase the energy and lower the density as well

Table I. Outcome of CO<sub>2</sub> laser treating acne scarring at different follow-up time periods.

	Poor	Fair	Good	Excellent
3 months after 3 laser treatments	9	11	9	2
12 months after 3 laser treatments	6	13	8	4

The majority of patients showed post-treatment improvement. There was no statistical difference between 3-month and 12-month follow up ( $\chi^2 = 1.514$ ,  $p = 0.652$ ), but improvement between two follow up visits is seen.

to achieve better improvement without increasing the adverse events. At the settings we used in our study, these adverse events were slight and transient, resolving within 2–5 months without intervention. There was no incidence of hypopigmentation, permanent depigmentation, infection, or scar worsening seen in any of the patients in this study. In contrast to traditional ablative CO<sub>2</sub> laser which has the potential for severe adverse events, the novel cool-scanned fractional CO<sub>2</sub> laser used in this study is much safer and more tolerable for Chinese individuals, reducing the risk and extent of complications (11).

In conclusion, we carried out a study on facial atrophic acne scarring treatment using high-energy pulsed and coolscanned CO<sub>2</sub> laser with FP mode in Chinese individuals. It is a safe and effective choice for acne scarring patients with minimal discomfort and shorter downtime as compared to traditional CO<sub>2</sub> laser therapy. It is likely to see even more post-treatment improvement with an increase in observation time.

**Declaration of interest:** Dr. Gold is a consultant, speaker and performs research for Lumenis. All other authors have no conflicts of interest to report. The authors alone are responsible for the content and writing of the paper.

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