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ORIGINAL ARTICLE

Clinical trial of a pinpoint irradiation technique with the CO_2 laser for the treatment of atrophic acne scars

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Abstract
Ablative laser resurfacing is an effective treatment for atrophic acne scars. However, it often induces complications such as edema, prolonged erythema, scarring and hyperpigmentation. Therefore, a new concept of laser treatment called fractional photothermolysis has been designed to create microscopic thermal wounds to achieve skin rejuvenation treatment of atrophic acne scars. This study was designed to prospectively evaluate the use of a technique similar to fractional photothermolysis using only the standard CO_2 laser without the fractional laser device in the treatment of atrophic scars and demonstrates it as a safe, effective and economical treatment option. Clinical improvement was achieved in all 35 patients with minimal adverse effects.

Key words: *Acne scars, CO_2 laser, fractional photothermolysis*

Introduction

Atrophic scars are dermal depressions commonly caused by the destruction of collagen after inflammatory acne. The psychological impact of acne, resulting not only from active disease but also from post-inflammatory scars, can be devastating.

Several kinds of treatment, including chemical peels, surgical excision, punch grafting, dermabrasion, and tissue augmentation with a variety of fillers, have been used to treat atrophic scars with varying degrees of success (1). But these treatments have been limited by incomplete scar removal and cosmetic complications. So, pulsed and scanned carbon dioxide (CO_2) and erbium:yttrium-aluminum-garnet (Er:YAG) laser resurfacing have been used for acne scar treatment (2–6).

However, they need an extended recovery period and often induce scarring and hyper- or hypopigmentation, especially in Asian patients. So, a new concept of skin laser treatment called fractional photothermolysis has been designed to create microscopic thermal wounds to achieve homogenous thermal damage at a particular depth within the skin, which differs from chemical peeling and laser resurfacing. Prior studies using fractional photothermolysis have demonstrated its effectiveness in the treatment of acne scars (7).

This study was designed to prospectively evaluate the use of a technique similar to fractional photothermolysis using only the standard CO_2 laser without the fractional laser device in the treatment of atrophic scars. Expectations were for the contractions of each small point, which was irradiated only on the atrophic area, to result in tightening of the acne scars and that the thermal damage would induce the elevation of concave scars as a result of the formation of new collagen.

Materials and methods

Thirty-five patients (10 women, 25 men; aged 20–27 years; mean age 22.6 years; skin phototypes IV–V) with moderate to severe atrophic facial acne scars were enrolled in the study. Exclusion criteria included concomitant treatments to involved skin areas, propensity for keloid scarring, pregnancy, immunosuppression, isotretinoin use, and filler injections within the preceding 6–12 months. The treatment areas were cleansed using a mild cleanser and boric acid gauze. Then, 25% lidocaine ointment was applied to the sites for 30 minutes.

Treatment was then delivered to the atrophic areas with pinpoint irradiations using a CO_2 laser (Ultra-30 Plus; Union-Medical Co.) at intervals of

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each irradiated dot size (0.3 mm). An output power of 2–5 W was applied to the scarred regions with a single ultra-pulse mode (pulse duration of 0.01 s). After pinpoint CO_2 laser irradiations, needling on the scar area with a 26 G needle was done. The depth of needling punctures was about 1 mm and this caused very tiny pinpoint bleeding. Pricking with only the bevel of the needle tip could help this depth to be reached. About 5 to 10 needling punctures were made on a 0.5–1 mm^2 atrophic area. Elicina cream (Lacofar y Cía Ltda.) was applied twice daily for the first few days after each treatment session.

The treatment was repeated up to five times at 2–3-week intervals.

Photographic documentation was obtained at baseline, before each treatment session, and 3 months after the final treatment. The results were evaluated and rated by both the patients and physician according to a four-point scale at the end of the treatments (A: excellent improvement; B: good improvement; C: fair improvement; D: no improvement).

Side effects and patient satisfaction surveys were recorded at each treatment session and follow-up visit.

Results

Clinical improvement was achieved in all 35 patients with minimal adverse effects consisting of mild transient erythema (Table I) (Figures 1 and 2). Immediately after treatment, the treated lesions were elevated because of edema (Figure 3). Some pinpoint-sized crusts and mild erythema were seen for 3–5 days after each treatment session. No patients

Table I. Evaluation of treatment using the CO_2 laser device at 3 months after treatment.

Case no.	Age/sex	Evaluation by patient	Evaluation by physician
1	22/M	A	A
2	24/M	B	B
3	21/M	B	A
4	23/M	A	B
5	21/M	A	A
6	20/M	A	A
7	21/M	A	A
8	24/M	A	B
9	27/F	A	A
10	24/F	A	A
11	26/F	A	A
12	22/F	B	A
13	21/M	A	B
14	20/M	A	A
15	22/F	A	A
16	22/F	A	A
17	21/F	A	B
18	23/F	B	B
19	21/F	B	A
20	20/F	A	A
21	23/M	B	A
22	24/M	A	A
23	21/M	A	B
24	23/M	A	A
25	24/M	B	A
26	22/M	B	A
27	21/M	B	A
28	22/M	A	A
29	21/M	B	B
30	20/M	A	B
31	22/M	B	A
32	20/M	B	B
33	22/M	A	B
34	22/M	A	A
35	22/M	A	A

A: excellent improvement; B: good improvement; C: fair improvement; D: no improvement.

Figure 1. Case 1: (A) before treatment; (B) 3 months after five sessions of treatment.

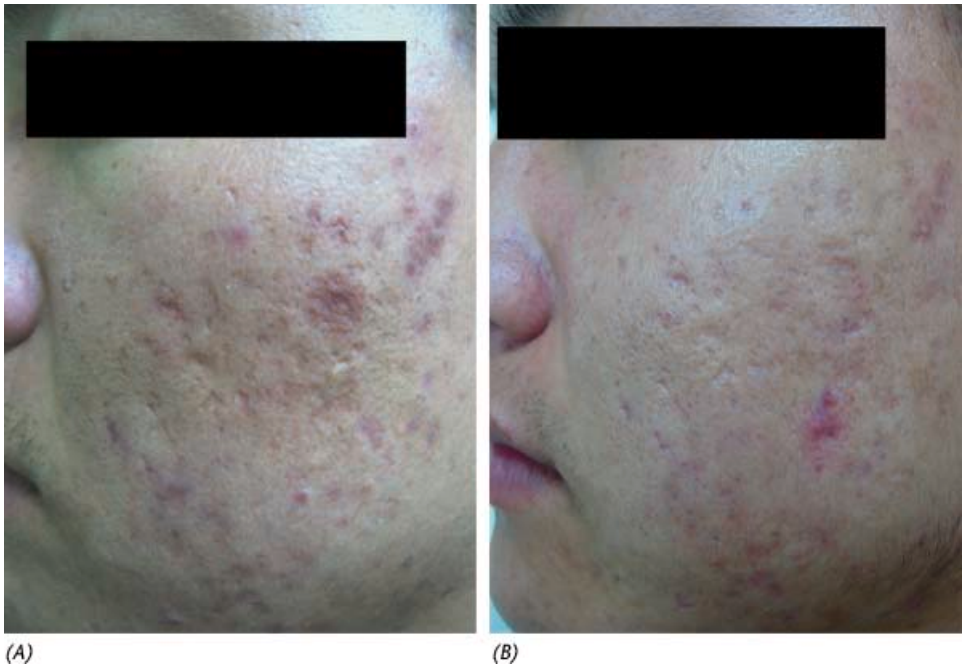

Figure 2. Case 5: (A) before treatment; (B) 3 months after five sessions of treatment.

showed scarring or hyperpigmentation as a result of treatment.

Discussion

Pulsed and scanned CO_2 and Er:YAG lasers are now the mainstays of laser resurfacing. Among them, a pulsed CO_2 laser is the most effective laser device for ablative skin resurfacing (2–6). However, edema and prolonged erythema are common. Scarring and hyperpigmentation may be induced (8,9).

Flash-lamps and radiowave devices as well as non-ablative lasers have been developed for skin tightening, and these are the so-called non-ablative dermal remodeling techniques. However, the results obtained after non-ablative laser scar revision using such systems as the long-pulsed 1,450-nm diode and 1,320-nm Nd:YAG lasers were not as impressive as those demonstrated with laser resurfacing (10).

So, the fractional photothermolysis system is a new concept for skin treatment similar to conventional laser resurfacing. They selectively damage the dermal tissue to induce a wound healing response that affects stimulation of prolonged neocollagenesis without damage to the epidermis to overcome the problems associated with laser resurfacing and chemical peeling (11).

Figure 3. Case 9: (A) before treatment; (B) immediately after first treatment; (C) 3 months after five sessions of treatment.

In a recent study, atrophic scars could be reduced with the 1,550-nm erbium-doped fiber fractional laser treatment (7). They treated atrophic scar and normal skin areas, so some additional effects on normal skin can be obtained. But also, some erythema and irritation could be seen in normal skin areas. It is felt that there is no need to treat a broad area including normal skin to improve atrophic acne scars.

In this study, the standard CO_2 laser and 26 G needle were used only on atrophic scar areas. So, the treatment parameters can be modified according to the condition of each scar. This scar-limited procedure may cause more localized responses such as thermal and mechanical damage, limited edema and erythema, which are needed for new collagen formation. With the fractional device and Roll-Cit device, scar-specific treatment for different shaped atrophic areas may be very difficult. These may be more inconvenient to patients compared with scar-limited treatment.

With the pinpointed irradiation, there were no complications that could be seen with conventional laser resurfacing and also the down-time is shortened to 3–5 days. All irradiated dots on the face were small freckle-like dry points of ablated epithelium which could be gently removed with moisturizer after 1 day. The color of the treated scar area was back to pink or normal by 2 or 3 days. Also, postoperative hyperpigmentation was not observed; this could be because there was no overlapped irradiation, no bulky damage and the time interval between each shot was relatively long.

The CROSS method, reported by Lee and colleagues, is a useful tool to treat acne scarring focally (12). But sometimes crusts and erythema were present more than 2 weeks after treatment.

Recently, some fractional photothermolysis systems with the CO_2 laser beam were developed (Active FX, Lumenis Co.; Thermoxel, Alma Asia Co.; Mixto SX, Lasering Co.). Their dot sizes are 0.12–1.3 mm and pulse durations are about 0.2–100 ms. Their dot pitches are 0.1286–1.66 mm and coverage percent after one pass is about 6–80%. But which parameters are ideal for the treatment of atrophic scars are not known as yet. The beam size of the CO_2 laser device in this study is 0.3 mm, pulse duration is 10 ms and the space between the irradiated dots was similar to the size of the dots.

Pinpoint single-mode irradiation with the CO_2 laser can give thermal damage, and the 26 G needling process can give mechanical damage to the dermis of scar lesions. These processes may induce new collagen formation. In this study, the skin cooling process was not done because the thermal effect limited to atrophic scars might have an advantage for collagen remodeling. But, with the treatment using the fractional photothermolysis device, the broad area including normal skin was also treated, so the skin cooling process should be done in Asian patients especially.

This study demonstrates the safe, effective and economical use of standard CO_2 laser equipment for atrophic acne scars. It is suggested that after elevation of atrophic scars with this method, additional treatment of the full area, including normal skin, using the fractional laser device is performed for a more excellent final cosmetic result.

References

1. Alster TS, Zaulyanov L. Laser scar revision: A review. Dermatol Surg. 2007 Feb;33(2)131–40. Review. No abstract available. Erratum in: Alster TS, Zaulyanov-Scanlon, Larissa. Laser scar revision: A review. Dermatol Surg. 2007 Jun;33(6):770.
2. Hruza GJ, Dover JS. Laser skin resurfacing. Arch Dermatol. 1996;132:451–5.
3. Waldorf HA, Kauvar ANB, Geronemus RG. Skin resurfacing of fine to deep rhytides using a char-free carbon dioxide laser in 47 patients. Dermatol Surg. 1995;21:940–6.
4. Lowe NJ, Lask G, Griffin ME. Laser skin resurfacing: pre- and post-treatment guidelines. Dermatol Surg. 1995;21: 1017–19.
5. Lowe NJ, Lask G, Griffin ME, Maxwell A, Lowe P, Quilada F. Skin resurfacing with the ultrapulse carbon dioxide laser: Observations on 100 patients. Dermatol Surg. 1995;21:1025–9.
6. Fitzpatrick RE, Goldman MP, Satur NM, Tope WD. Pulsed carbon dioxide laser resurfacing of photoaged facial skin. Arch Dermatol. 1996;132:395–402.
7. Alster TS, Tanzi EL, Lazarus M. The use of fractional laser photothermolysis for the treatment of atrophic scars. Dermatol Surg. 2007;33:295–9.
8. Nanni CA, Alster TS. Complications of carbon dioxide laser resurfacing. An evaluation of 500 patients. Dermatol Surg. 1998;24:315–20.
9. Ratner D, Tse Y, Marchell N, Goldman MP, Fitzpatrick RE, Fader DJ. Cutaneous laser resurfacing. J Am Acad Dermatol. 1999;41:365–89.
10. Tanzi EL, Alster TS. Comparison of a 1450-nm diode laser and a 1320-nm Nd:YAG laser in the treatment of atrophic facial scars: A prospective clinical and histologic study. Dermatol Surg. 2004;30:152–7.
11. Laubach HJ, Tannous Z, Anderson RR, Manstein D. Skin responses to fractional photothermolysis. Lasers Surg Med. 2006;38:142–9.
12. Lee JB, Chung WJ, Kwahck H, Lee KH. Focal treatment of acne scars with trichloroacetic acid: Chemical reconstruction of acne scars method. Dermatol Surg. 2002;28: 1017–21.