

Comparative Study of the Use of Ablative CO₂ Fractional Laser and Ablative Er:YAG Fractional Laser on Striae Distensae in Asian Women

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Background and Objectives

Treatment outcomes for striae distensae (SD) vary according to the modalities employed. Although the non-ablative fractional laser (FL) is reported to be effective in the treatment of SD, there has been no comparative study of the efficacies of ablative CO₂ and ablative Er:YAG fractional lasers. The aim of this study was to compare the clinical efficacy and patient satisfaction of these two laser treatments for SD associated with pregnancy.

Materials and Methods

Thirteen Korean women presenting with pregnancy-associated SD were treated with ablative CO₂ FL on one side and ablative Er:YAG FL on the other. All patients underwent at least two laser treatments at 4-week intervals. Two independent clinicians, blinded to the study details, evaluated clinical efficacy, and subjective satisfaction was assessed on a visual assessment scale (VAS). Side effects of treatment were determined 4 weeks after the last session of treatment.

Results

Mean evaluation scores recorded by physicians were low: 1.38 for CO₂ FL and 1.54 for Er:YAG FL ($p=0.62$). Mean VAS values were 2.08 and 2.15, respectively ($p=0.86$). There was no statistically significant difference between the clinical scores of two laser devices. Nine patients (69.2%) reported side effects including hyperpigmentation (7 patients) and pain (4 patients). Side effects were more often with ablative CO₂ FL than Er:YAG FL.

Conclusion

Our study revealed that clinical efficacies of both ablative FL on the treatment of SD were lower than that of previous reports. There was no significant difference between two lasers in clinical efficacy. And Er:YAG seemed to be more safe than CO₂ FL. Further studies are needed to optimize treatment protocol according to the patients' skin type of laser parameters.

Key words

Ablative CO₂ fractional laser; Ablative Er:YAG fractional laser; Pregnancy; Striae distensae

INTRODUCTION

Striae distensae (SD), also known as stretch marks, are cosmetic concern to many people. It has been reported that SD associated with pregnancy occur in as many as 70% of pregnant women and have a great influence on the quality of their lives, emotionally as well as cosmetically.¹ Although various treatment methods including pulsed dye laser (PDL) and intense pulsed light (IPL) have been tried, the results have been disappointing.² Recently, photothermolysis has been used to improve scars associated with acne and surgery. In 2009, Bak et al.³ suggested that fractional photothermolysis might be effective in treating SD without significant side effects. Thereafter, a few studies reported in the literature have tested the efficacy of fractional laser (FL) treatment for SD. However, there has been no comparative study of the use of ablative fractional lasers for treating SD in Asian women. The aim of this work was to compare clinical efficacy, side effects and subjective satisfaction after treatment of pregnancy-associated SD with ablative CO₂ FL and Er:YAG FL in Asian women.

MATERIALS AND METHODS

The study protocol conformed to the guidelines of the 1975 Declaration of Helsinki and was approved by the Hanyang Medical Hospital Institutional Review Board and Ethics Committee. Fourteen patients with pregnancy-associated SD (more than 3 years after delivery) participated voluntarily in the study. Patients with skin type of Fitzpatrick skin types III and IV were enrolled. Patients with skin diseases other than SD, with severe

abdominal obesity (BMI > 30), or who were pregnant or lactating were excluded. Informed consent was obtained from all patients.

Compartments of 10 × 10 cm² including the most severe area of SD were drawn on both sides of the lower abdomen. Topical lidocaine/prilocaine cream (EMLA[®] cream; Astra Pharmaceutical Products Inc., Westborough, MA) was applied under an occlusive dressing for 60 minutes. One side of the abdomen was then treated with ablative 2,940 nm Er:YAG FL (Spectra[™], Lutronic Co., Ltd, Seoul, Korea) using a 12 x 12 mm fractional hand piece at a fluence of 14 mJ/cm², density of 100 spots/cm² and in a single pass (5.5% coverage). The other side was treated with ablative 10,600 nm CO₂ FL (eCO₂[™], Lutronic Co., Ltd, Seoul, Korea) at a pulse energy of 30 mJ, a density of 100 spots/cm² and in a single pass (6% coverage). Standardized photographs of the front from each side were obtained before and after each treatment.

The laser treatments were performed at least twice on each patient at 4-week intervals. Clinical assessment was carried out by two blinded clinicians based on comparison of pre-treatment photographs with photographs taken 3 months after the last treatment. Each side was evaluated on a scale of 0 to 4 with: 0: worsened; 1: minimal improvement or unchanged (0-25%); 2: moderate improvement (25-50%); 3: marked improvement (51-75%); 4: near total improvement (> 75%). In addition, patient satisfaction was evaluated on a visual assessment scale (VAS) from 0 to 10; 0: not satisfied to 10: extremely satisfied. Side effects following the treatments were assessed by questionnaire.

The data were analyzed using the SPSS program

Table 1. Baseline patient characteristics and treatment outcomes

Patient no.	Age	Duration (years)	No. of treatments (mean = 3.8)	Physicians' evaluation scores		VAS		Side effects	
				CO ₂ FL	Er:YAG FL	CO ₂ FL	Er:YAG FL	CO ₂ FL	Er:YAG FL
1	36	5	5	1	1	2	3	Hyperpigmentation	
2	48	21	4	3	2	2	1		
3	33	5	5	1	2	2	2		
4	38	6	5	2	2	3	4		
5	38	9	5	1	2	2	3	Hyperpigmentation/Pain	
6	57	32	6	1	2	3	2	Hyperpigmentation	Hyperpigmentation
7	46	17	5	2	2	4	5		
8	31	3	3	1	1	1	1	Hyperpigmentation/Pain	Hyperpigmentation
9	47	20	3	1	1	2	3	Hyperpigmentation	
10	47	32	2	1	1	2	1	Pain	
11	45	19	3	2	2	2	1	Hyperpigmentation	
12	49	24	2	1	1	1	1	Hyperpigmentation	Hyperpigmentation
13	49	21	2	1	1	1	1	Pain	

(version 18.0) (IBM Co., Armonk, NY, USA). The Mann-Whitney U-test was used to compare differences between CO₂ FL and Er:YAG FL; significance was set at $p < 0.05$.

RESULTS

Demographic information

Of the fourteen patients enrolled, one dropped out for personal reason unrelated to the treatment. All the other patients were treated at least twice (mean, 3.8; ranges 2-6). Patient age ranged from 31 to 57 years (mean, 43.3 years). Mean duration of SD after pregnancy ranged from 3 to 32 years (mean, 16.5 years). The subtype of SD was striae alba in all the patients. Table 1 presents the demographic information in detail (Table 1).

Physicians' evaluations

For ablative CO₂ FL, 9 of the 13 patients (69.2%) were considered to show grade 1 improvement, 3 patients (23.1%) grade 2 improvement and the remaining patient (7.7%) grade 3 improvement (Fig. 1). For ablative Er:YAG FL, 7 patients (53.8%) were reported as showing grade 1 improvement and 6 (43.2%) grade 2 improvement (Table 1). The average score was low, 1.38 on the side treated with ablative CO₂ FL and 1.54 on the side treated with ablative Er:YAG FL (Fig. 2A). There was no significant difference between the two treatment modalities ($p = 0.62$).

Visual assessment scale (VAS)

In the survey of patients' cosmetic satisfaction, patients reported that they were generally unsatisfied with the

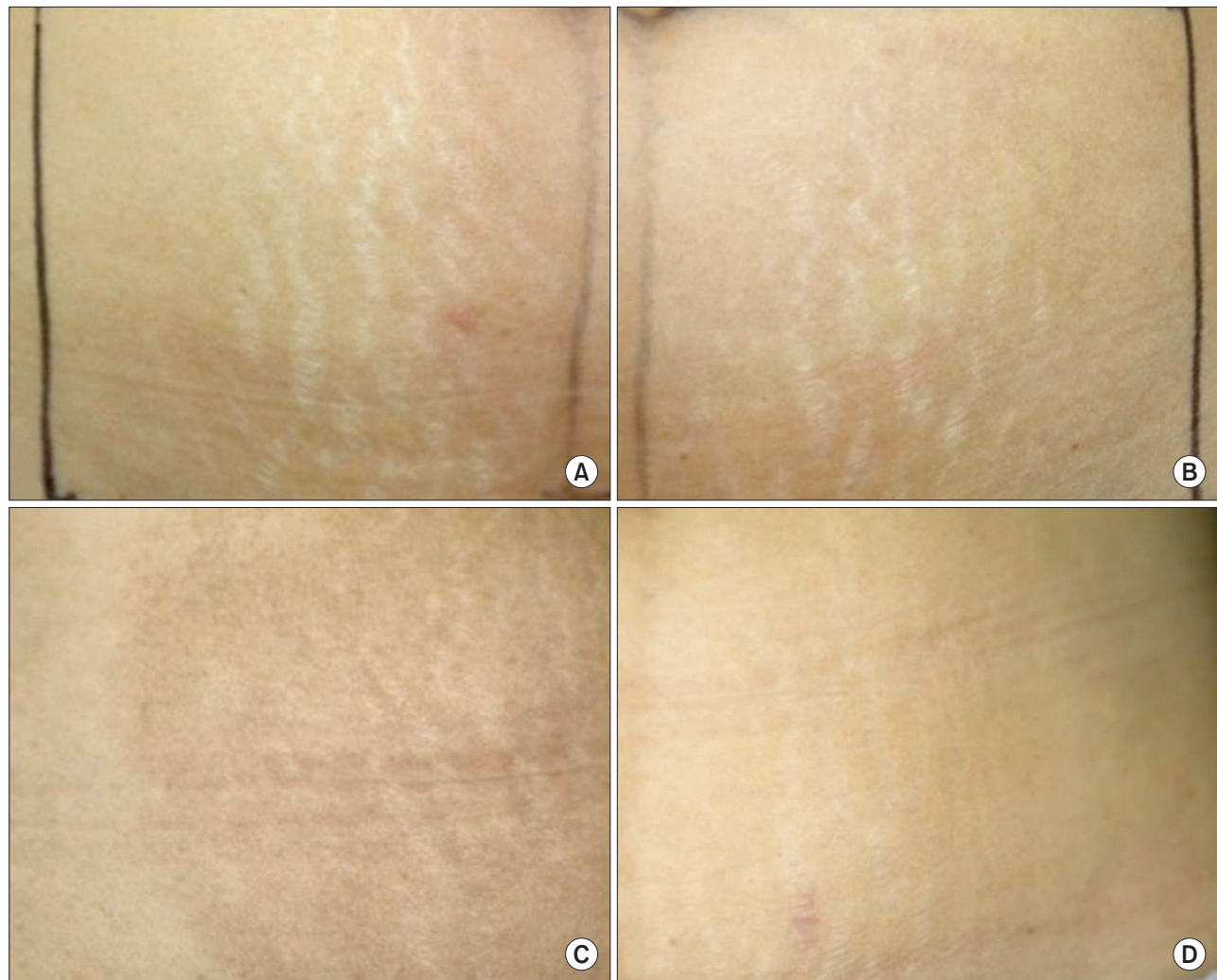


Fig. 1. Representative photographs of patient 7. Improvement in clinical appearance of striae distensae after treatment. Pre-treatment (A, B) and post-treatment with ablative CO₂ FL (C) and ablative Er:YAG FL (D).

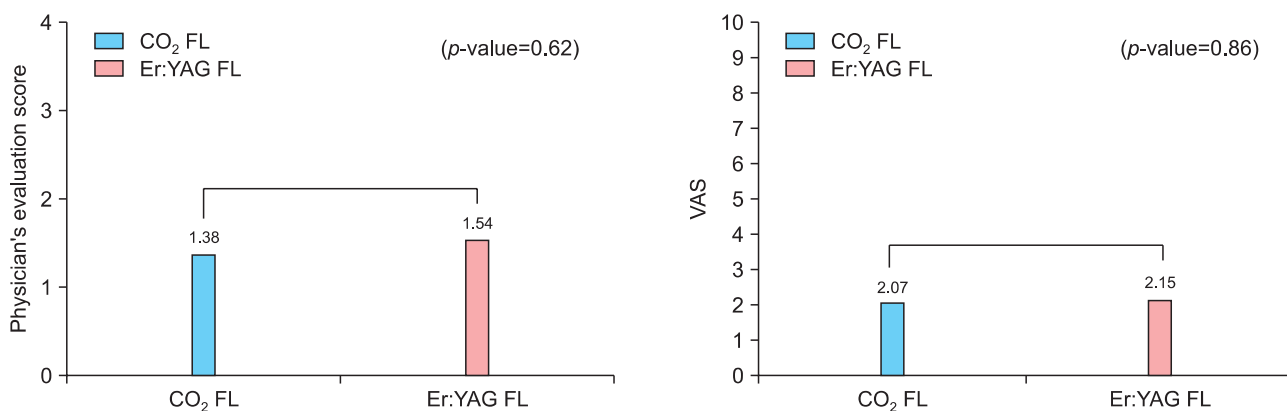


Fig. 2. (A) Physicians' scores evaluated 3 months after the final treatment were 1.38 and 1.54 for CO₂ FL and Er:YAG FL, respectively and not significantly different. (B) Visual assessment scales (VAS) were 2.08 and 2.15 for CO₂ FL and Er:YAG FL, respectively, and not significantly different.

treatment results. Mean scores were 2.08 and 2.15 for ablative CO₂ FL and ablative Er:YAG FL, respectively (Fig. 2B). There was no significant difference between the two modalities ($p = 0.86$) (Table 1).

Adverse effects

When we asked about adverse effects, the most common side effect was hyperpigmentation, reported by 7 of the 13 patients (53.9%). Of these 7 patients, 4 reported that they only had hyperpigmentation on the side treated with ablative CO₂ FL, and 3 reported hyperpigmentation on both sides (Fig. 3). Although the hyperpigmentation was not treated, it improved once the laser treatment was at an end. Pain was the second most frequently reported side effect, seen in 4 patients (30.8%), and it only affected the side treated with the CO₂ FL (Table 1). No other side effects, such as secondary infection, paresthesia and numbness were reported.

DISCUSSION

SD, one of the most common cosmetic problems, occur in obese people, adolescents with growth spurts and pregnant women. In particular, up to 70% of pregnant women are reported to suffer from SD, which never disappears. Histopathologically, there is a decrease in the thickness of the dermis, and sweat glands and hair follicles are usually absent. Therefore, treatment of SD is thought to be difficult, and most treatment modalities have been unsatisfactory. However, as concern about SD has increased, various novel treatment modalities have been tried. Topical tretinoin creams or low concentrations of trichloroacetic acid peels have been reported to have efficacy in improving SD.^{4,5} Recently, laser devices,

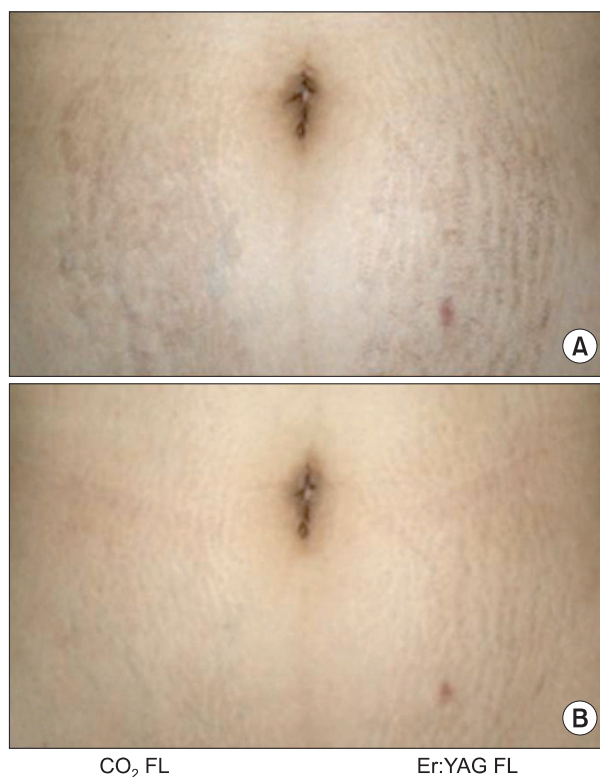


Fig. 3. (A) Clinical photographs of hyperpigmentation in patient after 2 week of first laser treatment with CO₂ FL on the right side and Er:YAG on the left side. (B) Hyperpigmentation resolved spontaneously in 4 weeks.

including fractional photothermolysis, 585-nm PDL, 1,450-nm diode lasers and nonablative radiofrequency therapy, have been reported to be effective.^{2,3,6}

CO₂ FL targets water with an infrared beam at 10,600 nm, causing controlled abrasion of the skin, and has been frequently used as a treatment for acne, pigmentation,

scars, open pores and photo-aged skin. It has been shown to cause immediate tissue tightening and induce collagen production.⁷ Since, as mentioned, stretch marks are thought to be dermal scars, CO₂ FL could theoretically be helpful. Lee et al.⁸ reported that of 27 patients treated with ablative CO₂ FL, 59% showed marked to near-total improvement. Shin et al.⁹ also reported that ablative CO₂ FL was effective. Er:YAG FL, at a wavelength of 2,940 nm, has also been reported to be useful and Stotland et al.¹⁰ obtained overall improvement ranging from 26% to 50% in 63% of participants after six sessions of SD treatment.

In contrast to these previously reported findings and our expectation that ablative CO₂ FL might be more effective because its wavelength is longer than that of ablative Er:YAG FL, physicians' evaluations and VAS for both were unsatisfactory in the present study, regardless of the number of treatments. The physicians' evaluation scores and the VAS scores were low and similar on both sides. However, both scores were lower for ablative CO₂ FL than for ablative Er:YAG FL. The difference between our results and those reported previously could be due to several factors. In our study, all the patients had striae alba whereas the previous studies included patients with striae rubra, and this may have led to poorer treatment responses in our case. We also observed more side effects of treatment than the previous studies. Lee et al.⁸ state that only a few patients had mild post-therapy hyperpigmentation. However, in our study, 53.8% of patients had post-therapy hyperpigmentation. Although the hyperpigmentation resolved spontaneously in a few weeks, we think that Asian skin types 3, 4, and 5 may be much more prone to developing side effects of ablative laser treatment than the skin of white Caucasians. There may also have been differences in the laser parameters, number and interval of treatment between our study and the others, as there is no standard protocol. Moreover, considering the side effects, ablative Er:YAG FL might be more recommendable than CO₂ FL.

This study had several limitations. First, there were only a small number of patients. Second, we did not carry out any histopathological examination. Third, there was no long-term follow-up and 2 patients only received two sessions of laser treatment because of side effects.

In conclusion, there was no significant difference between the clinical efficacy of SD treatment with ablative CO₂ FL and with ablative Er:YAG FL and the clinical

efficacy of both was lower than in the previous studies. After ablative CO₂ FL, there were more adverse effects including hyperpigmentation and pain than after ablative Er:YAG FL. Caution should be taken before performing aggressive ablative FL because of the possibility of side effects such as hyperpigmentation. Further studies are needed to optimize FL parameters and treatment intervals.

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