

Comparison of the fractional CO₂ laser and the combined use of a pulsed dye laser with fractional CO₂ laser in striae alba treatment

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Abstract

Background: No ideal treatment has been established for Striae distensae (SD), particularly in the late phase (Striae Alba (SA)). Various types of lasers have been recently proposed as treatment options for SD. This study aims to compare the clinical efficacy of a fractional CO₂ laser as well as a combination of fractional CO₂ laser and Pulsed dye Laser (PDL) in the treatment of SA.

Materials and Methods: Eighty-eight SA lesions in three female patients were included. Lesions on each half of the body were randomly enrolled in each group. Group 1 ($n = 44$) were treated by Fractional CO₂ laser resurfacing and group 2 ($n = 44$) by a combination of PDL and Fractional CO₂ laser, alternately. Digital Photographs were taken and the surface area of each lesion was measured digitally (using the PictZar Digital Planimetry Software) at the baseline and four weeks after treatment. The clinical improvement was assessed by comparison of the pre- and post-treatment photos and the participants' views about their degree of improvement, using a 10-point verbal analog scale (VAS).

Results: The mean surface area decreased significantly in both groups after treatment. The mean difference between the pre- and post-treatment surface area was 0.62 ± 0.53 for group 2 and 0.41 ± 0.43 for group 1 (P -value = 0.03). Mean VAS and dermatologist assessed improvement scale in group 2 (6.68 ± 0.77 and 2.2 ± 0.76 respectively) were significantly higher than those in group 1 (5.45 ± 0.90 and 1.8 ± 0.72 respectively, P -value < 0.001 and 0.04 respectively).

Conclusion: The combination of PDL and fractional CO₂ laser was more effective than fractional CO₂ laser alone and could be suggested as a clinical option in the treatment of SA.

Key Words: Fractional laser, pulsed dye laser, striae alba, striae distensae

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INTRODUCTION

Striae distensae (SD), also known as stretch marks, are dermal scars with a linear atrophic depression.^[1] SD is a common skin condition that does not cause serious medical problems, but commonly results in significant cosmetic concerns and emotional stress for those affected.^[2] SD frequently occurs in association with pregnancy, adolescent growth spurt, rapid

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increase or decrease in weight, obesity, high steroid hormone levels, and administration of potent topical corticosteroids.^[3-6] Clinically, early SD emerges as linear pink lesions that develop into longer and wider red lesions (striae rubra (SR)), which then become atrophic causing white scars (striae alba (SA)).^[7]

Various treatment modalities have been suggested for SD, with varying degrees of success, but no ideal method has been established. On the other hand, these modalities usually poorly affect mature striae (SA).^[8] In recent times, laser therapy has gained popularity as a treatment option for SD.^[2,9] Fractional photothermolysis (FP) stimulates the epidermal turnover and dermal collagen remodeling^[10] and has proven to be effective in the treatment of different kinds of scars.^[11] Regarding the histological similarities between SA and scars, and the role of collagen remodeling in SA, recently, FP has been evaluated and suggested as an effective therapeutic intervention for SD, and several studies have reported that it is effective in the treatment of SA.^[10-12] The pulsed dye laser (PDL) is a type of laser that has been mainly used in the treatment of vascular lesions.^[13] Several studies have evaluated the effect of PDL in the treatment of SD and its clinical efficacy has been reported on the striae in the rubra phase.^[2,14] According to our previous study,^[15] the SA lesions showed an SR-like appearance about one to three weeks after FP via fractional CO₂ laser. We hypothesized that the performance of PDL with the fractional CO₂ laser, for one to three weeks after treatment, could have an additional therapeutic effect on the SA lesions, with regard to the effect of PDL on SR.

Therefore, this study was conducted to compare the clinical efficacy of the fractional CO₂ laser alone and the clinical efficacy of a combination of PDL and the fractional CO₂ laser in the treatment of SA.

MATERIALS AND METHODS

This randomized clinical trial was conducted between November 2012 and November 2013. The participants were selected via simple random sampling from among patients referred to the Novin and Spadana Laser Centers, Isfahan, Iran. This study has been registered in the Iranian Registry of Clinical Trials (www.irct.ir, Registration code: IRCT2013123116013N1) and the study protocol was approved by the Ethical Committee of the Isfahan University of Medical Sciences (project number: 392210). Written informed consent was obtained from all the participants.

Three female volunteers with Fitzpatrick skin type III-IV, who had developed varying degrees of SA on

the abdomen, buttocks, and flanks were enrolled in the study.

The exclusion criteria were pregnancy, breast feeding, use of immunosuppressive drugs, propensity for keloids, previous treatment for SD, Cushing syndrome, connective tissue disease, and the use of vitamin A derivatives three months after the initiation of the study.

The body surface of the patients was divided into half using the midline. In each patient, pairs of SA, with an approximately symmetrical location and similar shape and size were selected. Lesions on one side of each patient were randomly allocated to group 1 and lesions on the other side to group 2. Finally, 88 lesion areas were included, 44 in each group. The lesions in group 1 were treated by three sessions of Fractional CO₂ laser resurfacing — three sessions with four-week intervals — while lesions in group 2 were treated by Fractional CO₂ laser (three sessions) and PDL (two sessions) alternately, with two-week intervals (the first session was Fractional CO₂ laser).

Prior to the procedure, a topical eutectic mixture of 2.5% lidocaine hydrochloric acid and 2.5% prilocaine (as anesthetic) were applied to the lesions under occlusion for one hour and then washed off. Laser resurfacing was done by a dermatologist using the Fractional CO₂ laser (Qray FRX, DOSIS M and M Co., Ltd.). The characteristics of the instrument were as follows: Laser type: Ultra pulse, 10600 nm, CO₂ tube; Output energy: 140 mJ; Pulse duration: 20-9540 μ s; Scanning size: 3 \times 3 mm to 20 \times 20 mm; and Density: 0.5-2.0 mm. Our chosen setting was: Laser Fluence: 16 \pm 2 J / cm², Dot cycle: 5 \pm 2, and Pixel pitch: 0.8 \pm 0.1. The 585-nm PDL (N-lite) was used at a fluence of 5-7 J / cm² and pulse duration of 0.5 ms, using a 7 mm spot size.

If any evidence of post-inflammatory hyperpigmentation (PIP), severe erythema or edema was observed after fractional CO₂ laser therapy, the laser setting was changed by lowering the fluence, decreasing the Dot cycle or increasing the Pixel pitch.

The participants were instructed to clean the site of laser therapy with sterile normal saline solution and use a sterile Vaseline gauze following resurfacing. The participants were followed up every other week after the treatment, for two months, to check for adverse effects.

High resolution digital photographs were taken of all the striae using identical camera settings (Canon PowerShot S95, Tokyo, Japan), patient positioning, and room lighting at the baseline and four weeks

after completing the treatment. The photographs were analyzed and the surface area of every stria was measured digitally (using PictZar Digital Planimetry Software, Ver 5.05.2, Biovisual Technologies, New Jersey, USA). In addition, the pre- and post-treatment photos were compared by an attending dermatologist, who was not otherwise involved in the study and blinded to the treatment modality used. The percentage of improvement was determined using a quartile grading scale as follows: 1 = weak (improvement 0-25%), 2 = moderate (improvement 26-50%), 3 = good (improvement 51-75%), 4 = excellent (improvement > 76%). Finally, the patients were asked to express their views about the degree of improvement in the lesions on each half of their bodies on a 10-point verbal analog scale (VAS), which ranged from 0 = no improvement to 10 = complete improvement.

All statistical analyses were performed using the Statistical Package of Social Sciences (SPSS) version 19.0 (SPSS, Chicago, IL, USA). The independent and paired *t*-tests and the chi-square test were used. The descriptive statistics were expressed as mean ± standard deviation or number (percentage in parentheses). A *P*-value less than 0.05 was considered to be statistically significant.

RESULTS

Three patients with a mean age of 31.2 ± 11.5 years participated in this study.

The mean surface areas of the striae before treatment were 3.76 ± 2.3 in group 1 and 3.48 ± 1.9 in group 2. There was no significant difference found between the two groups by using the independent *t*-test. Thus, we can say that these two groups were similar in the area of striae before treatment [Table 1] (*P*-value > 0.05).

The mean surface area of the striae was more in group 1 than in group 2, which was significant (3.29 ± 2.31 vs. 2.86 ± 1.67, *P*-value = 0.019).

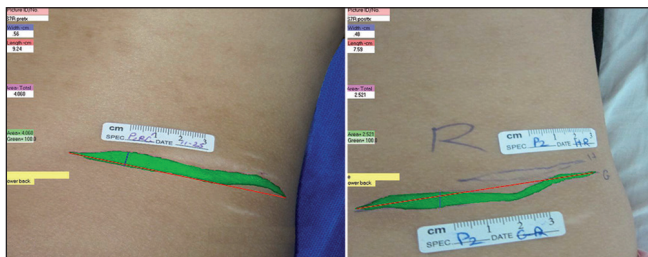


Figure 1: A stria alba lesion on the right flank (a) At baseline and (b) four weeks after the last treatment by Fractional CO₂ laser (three sessions) and PDL (two sessions) alternately with two-week intervals. The green areas denote the measured area by software

The paired *t*-test showed that the mean surface area of the lesions decreased significantly in both groups after the treatment (*P*-value = 0.011 for group 1 and 0.001 for group 2). The mean difference in the pre- and post-treatment surface area for group 2 (0.62 ± 0.53) was significantly more than that in group 1 (0.41 ± 0.4), which was statistically significant (*p*-value = 0.03) [Table 1, Figures 1 and 2].

Figure 1 shows the measured area of an SA lesion in group 2 at the baseline and four weeks after the last treatment.

The frequency distribution of the dermatologist-assessed improvement scales has been presented in Table 2. The mean dermatologist-assessed improvement in group 2 (2.2 ± 0.76) was significantly higher than in group 1 (1.8 ± 0.72, *P* = 0.048). Also the mean VAS in group 2 was significantly higher than that in group 1 [Table 2].

Table 1: Mean surface area before and after treatment modalities

| Variable | Group 1 | Group 2 | <i>P</i> value** |
|-------------------------------|-----------|-----------|------------------|
| Surface area before treatment | 3.76±2.3 | 3.48±1.9 | 0.55 |
| Surface area after treatment | 3.29±2.31 | 2.86±1.67 | .019 |
| <i>P</i> -value*** | 0.011 | 0.001 | |

*Data are expressed as mean ± standard deviation, **Tests used was the independent sample *t*-test, ***Test used was the paired sample *t*-test

Table 2: Dermatologist-assessed improvement score and mean VAS in both groups

| Score | Group 1 (%) | Group 2 (%) | <i>P</i> -value |
|------------------------|-------------|-------------|-----------------|
| Dermatologist-assessed | | | |
| Grade 1 | 14 (31.8) | 9 (20.5) | 0.048 |
| Grade 2 | 21 (47.7) | 17 (38.6) | |
| Grade 3 | 9 (20.5) | 18 (40.9) | |
| Grade 4 | 0 | 0 | |
| VAS | 5.45±0.90 | 6.68±0.77 | <0.001 |

*Data are expressed as mean ± standard deviation and Number of patients (%), Tests used are the chi square and independent sample *t*-tests

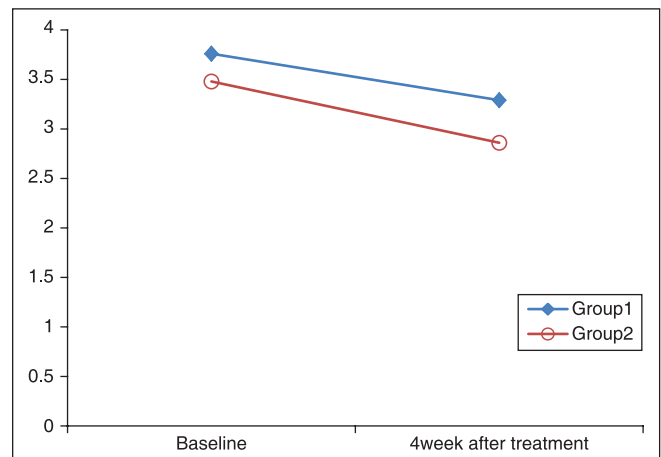


Figure 2: Steria alba lesion At baseline and four weeks after the last treatment by Fractional CO₂ laser

There were no significant adverse effects except a PIP in one patient that occurred in the locations treated by fractional laser alone and Hydroquinone cream was administered for these lesions.

DISCUSSION

In this study we compared the efficacy of fractional CO2 laser alone and the efficacy of a combination of PDL and fractional CO2 laser, in the treatment of SA. This investigation showed that the combination of PDL and the fractional CO2 laser brought about higher patient and physician satisfaction and a greater reduction in the surface area of the lesions.

Histologically, early striae lesions show inflammatory changes, dilation of venules, and edema in the upper dermis. Late stage striae is characterized by thinning of the epidermis due to the flattening of the rete ridges and reduced and reorganized elastin and collagen fibers.^[16] Fractional photothermolysis (FP) creates microscopic noncontiguous zones of thermal injury in the dermis called microthermal zones (MTZs). These areas are surrounded by islands of intact tissue from which the keratinocytes migrate to the MTZs and repair these damaged zones. On the other hand, these localized damaged columns contain thermally denatured collagen that stimulates collagen remodeling.^[10]

Our results showed that the fractional CO2 laser was effective in the treatment of SA lesions (although less effective than the combination of Fractional CO2 and pulsed dye laser (PDL), which was consistent with the previous investigations).^[2,7,8,10,15]

Kim *et al.* used a 1550-nm erbium-doped FP laser to treat six female volunteers with chronic SA. They reported that the epidermal thickness, collagen, and elastic fiber deposition significantly increased, as was seen in the histological findings. In addition, the macroscopic appearance showed an appreciable improvement eight weeks post treatment. The patients' satisfaction and skin elasticity increased eight weeks post treatment compared to four weeks post treatment.^[12] Our follow-up period was four weeks; however, longer follow up periods could change the obtained results. Stotland *et al.* confirmed the safety and clinical efficacy of the same laser (1550-nm erbium-doped FP) in the treatment of SR and SA. We used the 10600 nm fractional CO2 laser, but our results were in line with these studies.^[17]

Bak *et al.* reported that 27% of the patients, who had SD treated by FP showed a marked (50-75%) improvement and the other 63% showed mild (<50%) clinical improvement, based on the analysis of photos,

by two dermatologists. The thickness of the epidermis and dermis and the procollagen type 1 content of the skin increased after treatment. On the other hand, most of the clinically marked results were obtained in lesions that were white in color and had a long duration. Therefore, it has been suggested that FP is more effective in patients with SA rather than in those with striae rubra.^[10]

Lee *et al.* investigated the therapeutic efficacy of an ablative 10,600-nm CO2 fractional laser (the same laser used in our study) for the treatment of 27 patients with SA. Clinical assessments of the lesions showed that 7.4% of the patients had >75% clinical improvement (grade 4), 51.9% of the patients had 50-1 75% improvement (grade 3), 33.3% of the patients had 50-75% improvement (grade 2), and 7.7% of the patients had <25% improvement (grade 1). In our study, 20% of the patients in the Fractional CO2 laser group showed grade 3 clinical improvement, 47% had grade 2 improvement, 31% had grade 1 improvement, and no lesion was rated as grade 4.^[18] In comparison to the results of our study the better results obtained by Lee *et al* which have been explained by the different settings of the laser procedure or a longer follow-up period (as mentioned in the Kim *et al* study). On the other hand, this grading was based on observation and a physician's opinion, which could influence the results. Our previous study determined that the 10,600-nm CO2 fractional laser was clinically more effective than 10% glycolic acid + 0.05% tretinoin cream for the treatment of SA lesions.^[15]

In this study, the Fractional Co2 laser resulted in a greater improvement when combined with PDL compared to when it was used alone. It has been reported that PDL can bring about a significant improvement in early (rubra) phases of SD, by increasing the extracellular collagen content.^[2,14]

Jimenez *et al.* evaluated the effect of the 585-nm PDL in the treatment of nine patients with striae rubra (red or pink in color) and 11 with striae alba (white in color). The color and area of the striae were assessed using a VAS and the clinical parameters and collagen changes were evaluated using a hydroxyproline assay. A significant beneficial effect was reported on the SR lesions, but no apparent clinical improvement was seen in the SA lesions.^[2]

Our study is the first one that combines the therapeutic effects of both PDL and Fraxel CO2 in the treatment of SA. According to our previous study^[15] and our observations in this study, one to three weeks after treatment with the Fractional CO2 laser, the SA lesions showed an erythematous phase, with an

appearance similar to SR. Knowing the effect of PDL on SR,^[2,14] the therapeutic effect of PDL after fractional CO₂ laser could be due to its effect on the erythematous phase, which was similar to SR.

There were some limitations in our study. First, we did not perform a histological study on the treated lesions. The benefit of this assessment was to determine the histological and subclinical changes in the lesions and to determine that the improvements in aspects other than the size of lesions could be objectively compared, but unfortunately the patients had not agreed to do the biopsy. Second, due to the fact that there was no previous experiment on the performance of this combination in the treatment of SA, we conducted the study on our protocol. Different laser settings or number of sessions could bring about better results.

CONCLUSION

This study indicated that a combination of the pulsed dye laser and the Fractional CO₂ laser was more effective than the Fractional CO₂ laser alone, in the treatment of SA. Therefore, this combination could be suggested as a clinical option in treating SA. Further studies are needed to compare this treatment with other treatment modalities and to introduce new protocols in this area.

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