



Effectiveness of Fractional CO₂ Laser and Topical *Centella asiatica* Combination Therapy in Striae Distensae (Stretch Marks)

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Abstract

Introduction: Striae distensae (SD) are a skin disorder characterized by linear atrophic depression of the dermis due to stretching of the skin. There are various SD therapy modalities, namely topical therapy, peeling, microneedling, platelet-rich plasma, and laser. Until now, there has been no standard therapy for SD, but several therapeutic modalities can reduce clinical symptoms, so knowledge about the current management of SD is needed.

Methods: The research method used an experimental research design with consecutive sampling technique in SD patients at the Dermatology, Venereology and Aesthetics clinic of Mohammad Hoesin Hospital, Palembang, during the research period. This study aimed to determine the effectiveness of combination therapy with fractional CO₂ laser and *Centella asiatica* in SD.

Results: This study included 22 SD patients who met the inclusion criteria and received combination therapy with fractional CO₂ laser and *Centella asiatica*. The results of the analysis of differences in the Index of Striae Distensae Assessment (INA) score, Dermatology Life Quality Index (DLQI) score and VAS score revealed that there was a significant difference in the mean decrease in the INA score between the baseline and week 12 ($P=0.014$), as well as in the DLQI score between the baseline and week 12 ($P=0.000$). There was a significant difference in the mean VAS score between the baseline and week 4 ($P=0.000$).

Conclusion: These findings indicate that the combination of fractional CO₂ laser and topical *Centella asiatica* effectively reduces the severity of SD, improves patients' quality of life, and decreases associated pain. Further studies could explore long-term effects and optimize treatment protocols for even better outcomes.

Keywords: Striae distensae; Fractional CO₂ laser; *Centella asiatica*; Stretch marks.

Introduction

Striae distensae (SD), also called stretch marks, are a skin disorder characterized by linear atrophic depression of the dermis due to stretching of the skin.¹⁻³ SD are most often found during pregnancy and puberty with a prevalence ranging from 11% to 88%.^{4,5} Based on patient epidemiological data, Outpatient Clinic of Dermatology, Venereology and Aesthetics (DVE) at Mohammad Hoesin Hospital (RSMH) in Palembang found 12 SD cases from January 2015 to December 2020 with a female: male ratio of 3:1 and an age range of 12-33 years.⁴

Kaveri and colleagues' research reports that SD have negative effects and increase psychological and emotional stress, including feelings of lack of self-confidence and decreased quality of life. Around 25% of the research sample stated that the emotional stress caused by SD was

similar to or even more than that caused by acne, psoriasis, or dermatitis.⁴ Research conducted by Özge et al in 2021 reported that SD not only cause aesthetic problems but also have a psychological impact on teenagers.⁵

Until now, the etiopathogenesis of SD has been unclear; it is thought that there is a change in the structure of the dermis connective tissue due to reduced genetic expression of extracellular matrix components, namely fibrillin, elastin, fibronectin, and collagen. Other causes that play a role are mechanical and hormonal skin stretching.²

Various SD therapy modalities include topical therapy, chemical peels, microneedling, platelet-rich plasma, and laser. So far, there has been no standard therapy for SD, but several therapeutic modalities can reduce clinical symptoms, so knowledge about the current management of SD is needed.⁶ Research by Sany et al. reported that the

fractional CO₂ laser has proven effective as SD therapy.⁷ The fractional CO₂ laser can function as laser-assisted drug delivery (LADD) through the microchannels formed to increase the penetration of topical drugs such as growth factors.⁸

Centella Asiatica plays a role in stimulating fibroblasts and cell proliferation. Mendes and colleagues' research reported that *Centella Asiatica* significantly improved skin elasticity and clinical manifestations of SD. *Centella asiatica* contains active compounds including triterpenoid saponins such as asiaticoside, centelloside, madecassoside, and asiatic acid. The content of asiaticoside is a major compound of around 84% in the water extract, plays a role in inducing type I collagen synthesis by fibroblasts by phosphorylating Smad 2 and Smad 3, and binds Smad 3 and Smad 4 so that it can be used for SD therapy.^{9,10} Apart from that, *Centella asiatica* also contains saponins, which play a role in maintaining skin moisture by reducing the evaporation of fluid in the epidermal layer.⁶ Despite the promising findings, research on the effectiveness of combining fractional CO₂ laser and *Centella asiatica* therapy for SD remains limited, highlighting the need for further investigation into this combined treatment approach.

Methods

This study was an assessment of the effectiveness of the fractional CO₂ laser with a fluence 5 mJ, size 20×10 mm (5% overlap), distance 0,5 mm, 1 stack, and topical *Centella asiatica* in SD. This study used an experimental research design with a consecutive sampling technique. This research has been approved by the Research Ethics Commission of Mohammad Hoesin Hospital, Palembang, Indonesia. For the sample size, we determined the minimum required by using the consecutive sampling technique. The initial minimum was set at 20 samples to ensure reliable analysis. However, to account for potential dropouts, we increased the total sample size to 22 samples.

The research was conducted at the DVE RSMH Palembang outpatient clinic in May-July 2023. The research population was SD patients in the DVE RSMH Palembang outpatient clinic during the research period. The research inclusion criteria were SD patients, aged 20-50 years, willing to participate in the research, and they signed informed consent after receiving an explanation to take part in the research, medical procedures and taking photographic documentation. Exclusion criteria included pregnancy, breastfeeding, blood clotting disorders, antineoplastic therapy (chemotherapy, radiotherapy), history of keloids, active infection, unrealistic expectations, and uncooperativeness.

The research data were analyzed by using both univariate and bivariate analysis with SPSS version 22.0 (SPSS, Inc., Chicago, Illinois). Initially, univariate analysis was conducted to describe the basic characteristics of the

data. This involved presenting the results in the form of frequency distribution tables, which provided a clear overview of the number and percentage of occurrences of various variables within the dataset.

Subsequently, bivariate analysis was performed to explore the relationships between two variables. This analysis aimed to determine the correlation, mean values, and standard deviations related to the final evaluated outcomes including the Index of Striae Distensae Assessment (INA) score, the dermatology life quality index (DLQI), and the visual analog scale (VAS). For the normality test, if the data were normally distributed, the results were obtained by using the paired *t* test. If the data were not normally distributed, the Wilcoxon test was used instead.

Results

Distribution of Research Subject Characteristics

Based on the data on the frequency distribution of the characteristics of research subjects during the period from May to July 2023, a total of 22 patients were analyzed. The most common age distribution was in the range of 25-34 years, with 11 individuals (50%). The female gender was more prevalent, comprising 15 individuals (68.2%). A normal body mass index (BMI) was observed in 12 individuals (54.4%). Striae distensae were most frequently found in female research subjects with a history of 2 deliveries, accounting for 31.8% of the cases (Table 1).

Distribution of Lesion Characteristics

The distribution of lesion characteristics includes Fitzpatrick skin type, location, and type of striae. Based on the results, it was found that the Fitzpatrick III skin type, observed in 19 individuals (86.4%), was the most common. The most frequent location of the striae was on the abdomen, with 14 individuals (63.6%) affected. Striae alba was the most frequently found type, present in 18 individuals (81.8%) (Table 2).

Distribution and Effectiveness of the INA Score, VAS Score, and DLQI Score

The results of the analysis showed that the mean baseline INA score was 7.04 ± 1.21 , which decreased to 6.77 ± 1.06 after 12 weeks. Similarly, the baseline DLQI score, which was 9.72 ± 1.88 , significantly decreased to 3.18 ± 1.78 at the end of the study period. For the VAS scores, the mean score for the first measurement (baseline) was 4.36 ± 0.95 , which was reduced to 3.00 ± 1.02 by the second measurement in week 4 (Table 3).

The statistical analysis of the differences in INA scores, DLQI scores, and VAS scores revealed significant improvements. The mean INA score showed a significant reduction from the baseline to week 12 ($P=0.014$, $P<0.05$). Similarly, the mean difference in DLQI scores between the baseline and week 12 was highly significant

Table 1. Distribution of Characteristics of Research Subjects

Characteristics	Number	Percent
Age		
20-24 years old	6	27.3
25-34 years old	11	50.0
35-45 years old	4	18.2
>45 years old	1	4.5
Gender		
Man	7	31.8
Woman	15	68.2
Work		
Student	6	27.3
Employee	7	31.8
Doctor	9	40.9
Body mass index		
Normal	12	54.4
Overweight	6	27.3
Obesity	4	18.2
Maternity status		
No	11	50.0
1 time	1	4.5
2 times	7	31.8
3 times	2	9.1
4 times	1	4.5

($P=0.000$, $P<0.05$). Additionally, the VAS scores demonstrated a significant decrease from the baseline to week 4 ($P=0.000$, $P<0.05$) (Table 4).

These results indicate that the treatment was effective in reducing the severity of SD, improving patients' quality of life, and decreasing pain levels.

INA Score Components

The components of assessing SD characteristics based on the INA score include number, size, type of SD, and itching. Based on the results, it was found that the decrease in mean size of SD from the baseline of 8.02 ± 2.97 to 4th week (7.18 ± 2.85) and 12th week (6.13 ± 2.52). Meanwhile, at the baseline, there were two patients who experienced itching, but at week 2, week 4 and week 12 there were no patients who experienced itching (Table 4).

Discussion

Research by Mendes et al, in 2022, showed that SD occur more often in women than men.¹¹ The incidence of SD occurs more often in adult women after puberty or during pregnancy, while in men generally occur at the same time as growth spurts or increasing in body mass index.¹² In this study, it was revealed that SD were found more often in women (n=15) than men (n=7). The results of this study are in accordance with research by Lokhande and Mysore who reported that SD were found twice as often

Table 2. Distribution of Clinical Characteristics

Clinical Characteristics	Number	Percent
Fitzpatrick's skin type		
Type III	19	86.4
Type IV	3	13.6
Location of striae		
Axillary	2	9.1
Abdomen	14	63.6
Femoral	3	13.6
Gluteus	2	9.1
Popliteal	1	4.5
Types of striae		
Striae alba	18	81.8
Striae rubra	4	18.2

Table 3. Distribution and Effectiveness of INA Score, DLQI Score, and VAS Score

Variable	N	Mean ± SD	Median (Min-Max)	P Value
INA score				0.014
Baseline	22	7.04 ± 1.21	8 (4 –8)	
Week 12	22	6.77 ± 1.06	7 (4-8)	
DLQI score				0.000
Baseline	22	9.72 ± 1.88	10 (6-15)	
Week 12	22	3.18 ± 1.78	3 (1-7)	
VAS score				0.000
Baseline	22	4.36 ± 0.95	4 (3-6)	
Week 4	22	3.00 ± 1.02	3 (1-7)	

in women as in men.² The results of this study are in accordance with research by Lokhande and Mysore who reported that SD can be found in the age range of 5-50 years and most often in the age range of 20-35 years.² The age range of the subjects of this study was 21-49 years with a mean of 31 years, and most (11 people (50%)) were found in the age range of 25-34 years.

A cross-sectional study by Osman et al showed that SD were more common in women with Fitzpatrick III (41%) and IV (32%) skin types.¹³ Piérard-Franchimont and colleagues' study on SD in dark skin types indicated that hypopigmentation in striae alba is influenced by mechanobiological processes or the process of inhibiting melanogenesis. Apart from that, SD color variations are influenced by microvascular size and melanocyte activity.¹⁴ Kang et al showed that the use of *Centella asiatica* as a topical agent after fractional CO2 laser treatment can reduce the side effects of hyperpigmentation after laser treatment. The content of asiaticoside and madecassoside plays a role in increasing collagen and fibronectin production after topical application of *Centella asiatica*, as well as facilitating wound remodeling by increasing the synthesis of type I and III collagen.¹⁵

In a study, Lokhande and Mysore reported that SD can

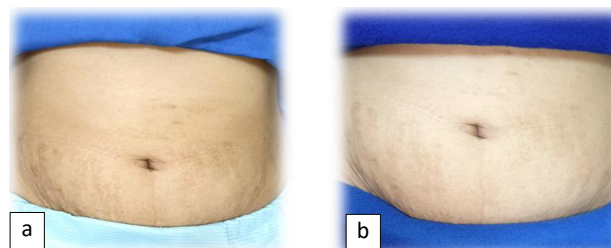
Table 4. INA Score Components

INA score	Baseline	Week 2	Week 4	Week 12
Total				
Mean ± SD	14.04 ± 7.09	14.04 ± 7.09	14.04 ± 7.09	14.04 ± 7.09
Median (min-max)	14.5 (3-26)	14.5 (3-26)	14.5 (3-26)	14.5 (3-26)
Size				
Mean ± SD	8.02 ± 2.97	8.02 ± 2.97	7.18 ± 2.85	6.13 ± 2.52
Median (min-max)	8 (4-13)	8 (4-13)	6.5 (3.5-12)	5.5 (3-11)
Color				
Alba	18 (81.8)	18 (81.8)	18 (81.8)	18 (81.8)
Rubra	4 (18.2)	4 (18.2)	4 (18.2)	4 (18.2)
Itchy				
Yes	2 (9.1)	0 (0)	0 (0)	0 (0)
No	20 (90.9)	22 (100.0)	22 (100.0)	22 (100.0)

cause cosmetic and psychological problems, especially in certain professions that require an attractive appearance. This causes many patients to go to dermatologists for SD treatment. Although there have been several developments in SD treatment modalities, there has been no complete SD treatment yet.² in this study, it was found that the respondents' occupations were doctors (n=9), students (n=6), and employees (n=7). SD can affect the patient's quality of life and self-confidence due to an unattractive skin appearance.^{2,5}

Striae distensae are a common appearance problem in adolescents during puberty and in women of reproductive age or a history of pregnancy, obesity, and long-term use of systemic or topical corticosteroids. SD predilection is most common in the stomach, breasts, thighs, buttocks and calves. The initial clinical manifestation of SD is in the form of raised linear red spots (striae rubra). As the disease progresses, the raised linear red spots can change into hypopigmented spots (striae alba) due to damage to skin integrity in the form of elastin and collagen due to degranulation of mast cells in the dermis.⁷ This is in accordance with previous research. In this study, the predilection for SD was mostly found in the abdominal area (63.6%), femoral (13.6%), gluteus and axillary (9.1%), and popliteal (4.5%).

There are various choices of SD treatment modalities, but until now there has been no gold standard for SD treatment. Single treatment modalities for SD include topical treatments, lasers, light devices, and others. Laser procedures and light devices are reported to be more effective and widely used than topical treatments. In recent years, combination therapy of surgical procedures and topical treatments has been widely studied. Combination therapy is more effective in providing clinical improvement than single therapy; however, the success of combination therapy depends on the type of therapy used. The target of combination therapy is to increase collagen production,

**Figure 1.** Clinical manifestation (a) baseline (b) 12th week

reduce vascularization, increase pigmentation, and improve the clinical manifestations of SD.¹⁶

Lokhande and Mysore reported that *Centella asiatica* plays a role in increasing fibroblast production and is a topical treatment option for SD. It has an anti-inflammatory effect and can reduce the degree of SD.² Nuraini and Rahayu reported that *Centella asiatica* plays a role in increasing collagen and elastin production and improving hyperpigmentation and texture of lesions, and it can prevent progression and reduce the severity of SD.¹⁷ Sobhi et al reported that SD are often found in patients with Fitzpatrick skin types III (35.3%) and IV (58.5%), and no relationship was found between Fitzpatrick skin type and the incidence of SD.¹⁸ The results of this study follow previous research; that is, SD were found most often in Fitzpatrick III skin type (19 subjects (86.4%)).

According to research conducted by Sany et al, the fractional CO₂ laser contributes to improved clinical symptoms of SD by enhancing dermal coagulation and collagen formation. As a therapeutic option for SD, the fractional CO₂ laser contributes to the improvement of dermal structure and keratinocyte proliferation by using heat shock proteins in fractional photothermolysis technology.⁷ Mohamed Sobhi and colleagues' study on the effectiveness of the fractional CO₂ laser as a treatment modality in 17 SD patients found that the procedure was successful in improving the clinical characteristics of the patients' lesions, including appearance, size, texture, and DLQI.¹⁸

The combination of topical *Centella asiatica* with fractional CO₂ laser as a therapy for SD has not been thoroughly studied. Both are the preferred methods for managing SD, according to the literature. By enhancing the LADD effect, the CO₂ fractional laser not only helps the integrity of the dermis and epidermis but also aids in topical drug penetration. Therefore, as a treatment for SD, the combination of *Centella asiatica* and CO₂ fractional laser has a synergistic effect that improves skin integrity and aids in better topical drug absorption. The findings of the study indicate that the use of *Centella asiatica* in conjunction with the fractional CO₂ laser improved the degree of SD, as measured by the mean INA score, which dropped from 7.04 ± 1.21 at the baseline to 6.77 ± 1.06, notably in the areas of size and itching (Figure 1).

Although multiple prior trials have yielded good

outcomes with fractional CO₂ laser therapy for SD, discomfort is a common adverse effect of this method. According to the research conducted by Ryu et al on 30 women with moderate to severe SD in South Korea, the average pain scale for fractional CO₂ laser operations based on the VAS score was approximately 2.2, and they were generally well tolerated.¹⁹

According to the research conducted by Seong et al, fractional CO₂ laser treatment for SD was found to be a successful therapy technique, with a mean VAS score range of 6.9 ± 2.2 . One way to lessen pain during the CO₂ fractional laser process is to apply topical anesthetic beforehand.²⁰ The protocol of the study states that the patient receives topical anesthetic for 30 to 45 minutes prior to the CO₂ fractional laser operation in order to minimize pain. The findings of the study indicate that the average pain scale for the first surgery was 4.36 ± 0.95 based on the VAS score, and for the second procedure, it was 3.00 ± 1.02 based on the VAS score. The findings of this study suggest that the combination of fractional CO₂ laser and *Centella asiatica* as a therapy modality can treat SD with mild to moderate pain that can be tolerated quite well.

Research by Guida et al found that monitoring before and after fractional CO₂ laser treatment in patients with SD who were followed up for one month revealed a significant improvement in DLQI from the baseline ($M = 2.8 \pm 3.7$) compared to the end of follow-up observation ($M = 0.7 \pm 1.5$).²¹ Research by Nuraini and Rahayu found that applying *Centella asiatica* to SD was proven to improve both the clinical appearance of SD and DLQI from the baseline with a score ranging from 5.25 to 1.83.¹⁷ Based on the results of this study, there was an improvement in the DLQI of respondents from the baseline range of 9.72 ± 1.88 (moderate effect) to 3.18 ± 1.78 (mild effect) at week 12, so this combination of therapy may be able to improve DLQI.

The limitations of this study are as follows: The number of samples is relatively small, and a comparison with another modality therapy may have better results.

Conclusion

These findings indicate that the combination of fractional CO₂ laser and topical *Centella asiatica* effectively reduces the severity of SD, improves patients' quality of life, and decreases pain associated with the condition. The significant improvements in INA, DLQI, and VAS scores underscore the potential of this combined treatment approach for managing SD. Further studies could explore long-term effects and optimize treatment protocols for even better outcomes.

Authors' Contribution

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Validation: Yuli Kurniawati, Yulia Farida Yahya, Aryati Fadhila, M. Rezi Rahmanda, Nyimas Nursyarifah, Nanda Safira Alisa.

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Competing Interests

No conflict of interest

Ethical Approval

This research obtained agreement from ethical committee of Mohammad Hoesin Hospital Palembang on 15th June 2023 (DP.04.03/D.XVIII.6.11/ETIK/72/2023)

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