Review Article

Laser treatment for stretch marks: a literature review

Tratamento a laser para estrias de distensão: revisão bibliográfica

ANDRÉ COELHO NEPOMUCENO [1]*
LARISSA CASSEMIRO DA-SILVA [1]

■ **ABSTRACT**

Stretch marks are scars on the dermis that cause patients to be self-conscious and that pose challenges in clinical treatment. They result from rapid stretching of the skin and often observed in adolescents, pregnant women, obese individuals, and people experiencing rapid change in weight. They initially appear as erythematous and edematous plaques (red striae), and as they mature, they become whitish and atrophic (striae alba) due to the degradation and reorganization of elastin and collagen fibers. Currently, laser treatment is an emerging noninvasive therapeutic modality that is successful in reducing the excessive vascularization of red striae and in stimulating the production of collagen and elastin in the alba. In the present literature review, PubMed was searched for articles on the treatment of atrophic striations with laser that were published from January 2000 to December 2016. The authors have found 28 articles that met the inclusion criteria. Only few randomized clinical trials have evaluated the long-term efficacy and safety of energy-based treatments. Based on clinical cases and systematic reviews, both ablative and non-ablative fractional lasers caused moderate improvement in the appearance of distending striae. The 1540-nm non-ablative fractional laser is more likely to be considered the first-line treatment for stretch marks. However, future studies should focus on research with longer duration, studies with objective and standardized measures for the evaluation of results, such as biopsy results, and molecular studies showing an increase in elastic and collagen fibers that correlate to the improvement in the clinical appearance of the striae after using lasers with systematized parameters.

Keywords: Stretch marks; Laser therapy; Dermatology; Skin; Reconstructive surgical procedures.

Institution: Faculdade de Medicina, Pontifícia Universidade Católica de Campinas, Campinas, SP, Brazil.

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[1] Pontifícia Universidade Católica de Campinas, Campinas, SP, Brazil.

■ **RESUMO**

Estrias de distensão são cicatrizes na derme que constrangem os pacientes e oferecem desafios ao tratamento clínico. Resultam do rápido estiramento da pele, frequentemente presente em adolescentes, gestantes, obesos e indivíduos com rápida mudança de peso. Apresentam-se inicialmente como placas eritematosas e edemaciadas (estrias rubras) e, conforme amadurecem, tornam-se esbranquiçadas e atróficas (estrias albas), devido à degradação e reorganização de fibras de elastina e de colágeno. Atualmente, lasers representam modalidade terapêutica não invasiva emergente, que já demonstrou sucesso na redução da vascularização excessiva das estrias rubras, e no estímulo à produção de colágeno e elastina nas albas. Foi realizada revisão da literatura no PubMed referente ao tratamento de estrias atróficas com laser de janeiro de 2000 até dezembro de 2016. Os autores encontraram 28 artigos que se enquadraram nos critérios de inclusão. Existem poucos estudos clínicos randomizados avaliando a eficácia ao longo prazo e a segurança de aparelhos à base de energia. Baseado em casos clínicos e revisões sistemáticas, ambos os lasers - ablativo e não ablativo - fracionados demonstraram melhora modesta do aspecto das estrias distensas. Há tendência a sugestão do laser não ablativo fracionado de 1.540 nanômetro como sendo opção de primeira escolha para tratamento das estrias distensas. Porém, estudos futuros devem focar em desenhos de pesquisa com duração mais longa, medidas objetivas e padronizadas da avaliação dos resultados como biópsias e estudos moleculares, que demonstrem aumento nas fibras elásticas e fibras de colágeno, que correlacionem com a melhora do aspecto clínico das estrias após aplicação de lasers com parâmetros sistematizados.

Descritores: Estrias de distensão; Terapia a laser; Dermatologia; Pele; Procedimentos cirúrgicos reconstrutivos.

INTRODUCTION

Stretch marks are common linear atrophic dermatoses. Due to their non-esthetic nature, they have psychosocial implications that interfere with a patient's quality of life. The prevalence is twice as high in women than in men, and it occurs more commonly in Caucasians. Moreover, it is commonly observed during puberty, affecting approximately 30% of individuals in this age group worldwide, and during pregnancy, influencing around 75% of pregnant women[1].

Obesity, pregnancy, rapid weight gain or loss, adolescent growth, endocrine–metabolic syndromes, and prolonged exposure to corticosteroids are the factors associated with the development of stretch marks. However, its etiological mechanism is not fully understood[2].

Mechanical stretching of the skin is the most likely pathophysiological mechanism underlying the stimulation of mast cells that release proteolytic enzymes, such as elastases. This phenomenon leads to the elastolysis of existing elastic and collagen fibers and the decrease in fibroblast activity during high-quality synthesis of the extracellular matrix, culminating in the reorganization of the matrix and its fibers, and to a significant deficit in collagen and elastin fibers, thereby contributing to the atrophic appearance of stretch marks.

Initially, stretch marks present as erythematous and edematous linear plaques due to the inflammatory process triggered by the distension and degeneration of elastic fibers and degranulation of mast cells, characterizing the so-called immature striae or striae rubra. Over time, these striae undergo a maturation process, thereby becoming atrophic and hypopigmented, with the horizontal arrangement of the thin bundles of dense collagen, characterizing the mature striae or striae alba[1].

Although they are not life-threatening, in terms of esthetic aspects, improving the appearance of stretch

marks is essential for the self-esteem of individuals and adequate social interaction. However, stretch marks pose challenges in clinical therapy, particularly in relation to the presence of striae alba. The literature has reported several treatment modalities for stretch marks, which include chemical peels (glycolic acid), topical medications (tretinoin), silicone sheets, microdermabrasion, radiofrequency, phototherapy (ultraviolet A and B), and lasers[4].

In this context, lasers, which are less-invasive methods, have shown satisfactory results. That is, they have decreased the excessive vascularization of the striae rubra and stimulated the production of collagen and elastin in striae alba[5].

OBJECTIVE

This study aimed to carry out a literature review on the most relevant aspects of laser treatment for stretch marks between January 2000 and December 2016.

METHODS

The literature review only included original articles, case reports, and systematic reviews published between January 2000 and December 2016. The journals indexed in *Public Medical Literature Analysis and Retrieval System Online* (PubMed) database were considered. The descriptors used in searching for articles were *laser treatment* and *striae distensae*.

RESULTS

In the initial research carried out in PubMed, 36 articles were found, of which 28 were included in the review because they discussed the treatment for striations with a laser and they were published between 2000 and 2016. The articles included original articles, case series, and review articles.

DISCUSSION

Non-fractional laser releases a single beam of light that disperses energy from a central point. The fractional laser releases energy to the tissue through multiple microscopic columns surrounded by untreated areas. This pattern of microthermal heat zones delivers energy to the skin more evenly. It is possible to split a beam of light in both ablative and non-ablative lasers. Ablative lasers use long wavelengths to target the water present in both the epidermis and dermis, thereby vaporizing the cells[5].

The following are the categories of lasers for the treatment of stretch marks that were discussed in this study:

Non-ablative lasers

308-nm Xenon Chloride (XeCl) Excimer Laser

The excimer laser classically treats hypopigmented, psoriatic, and depigmented vitiligo lesions by means of dermal lesions that stimulate the formation of collagen and elastin. In a randomized clinical trial, 68% of repigmentation was observed after a mean excimer laser session of 9 months[6]. Another study has also evaluated the use of excimer laser in 10 patients with striae alba. Patients underwent approximately 9 weekly sessions of laser treatment with a fluence of 50 mJ/cm^2. Laser therapy caused increased pigmentation. However, only one patient presented with almost complete resolution and two had moderate improvement at 26%-50%. During follow-up, the clinical appearance of the skin returned to the initial pattern after 6 months, which indicated the need for frequent maintenance therapy. Excimer laser does not significantly improve texture and remove the redness of striae rubra. Moreover, it is not a therapeutic option for the re-pigmentation of striae alba[7].

577-nm Copper Bromide (CuBr) Laser

A case series has reported that five patients achieved a complete improvement in terms of the appearance of stretch marks, whereas 10 patients achieved 50%-90% improvement based on histologic measurements[8].

585- and 595-nm Pulsed Dye Laser (PDL)

PDL uses hemoglobin as the chromophore of the vessels. Thus, it is an effective treatment for erythema. Its mechanism of action also stimulates the reorganization of collagen and elastin in the skin, thereby improving the appearance of the lesions[9]. However, this modality is not indicated for patients with darker skin types since they may develop post-inflammatory hyperpigmentation. Jiménez et al.[10] have assessed the efficacy of the 585-nm PDL in 20 patients with stretch marks who received two treatments at an interval of 6 weeks, and these patients were assessed clinically and histologically 6 weeks after the second treatment. Only four red striae showed changes in pigmentation after treatment. No improvement was observed in the striae alba. However, the histological analysis revealed an increase in collagen in both the striae alba and rubra[10].

1064-nm Neodymium-doped Yttrium Aluminum Garnet (Nd:YAG) Laser

A series of cases has shown improvement in striae rubra after approximately four sessions, with satisfaction rated as "excellent" by 55% of the treated patients and 40% of the attending physicians[11].

Another study involving 45 patients with Fitzpatrick III–V skin type (23 with striae rubra and 22 with striae alba) were treated with an 1064-nm Nd:YAG laser with two different fluences: 75 J/cm^2 and 100 J/cm^2. The used spot was 5 mm, and the pulse duration was 15 ms. All patients underwent four sessions at an interval of 3 weeks. Three weeks after the last session, the results were clinically evaluated using photos and via biopsies. The appearance of striae alba significantly improved with Nd:YAG long pulse laser at a fluence of 100 J/cm^2, whereas the appearance of the striae rubra improved more with a fluence of 75 J/cm^2.

1410-, 1450-, 1540-, and 1550-nm Erbium:Glass (Er:Glass) Laser

Fractional lasers release energy that penetrates the superficial dermis producing heat columns called microthermal zones, and these are distributed through the treated area in a dotted pattern. The preserved areas in the skin around the dots serve as a nutritional and structural reservoir for healing to occur more quickly[5]. A randomized clinical study and eight case series on Er:glass laser were identified in this review.

The randomized clinical trial using non-ablative and non-fractionated 1450-nm Er:glass laser did not result in a significant improvement 2 months after treatment. This study examined 11 patients who underwent treatment with three fluence settings (4.8 or 12 J/cm^2) applied in three treatment sessions for 18 weeks. No difference was observed between the three fluence configurations in terms of improvement in the striae. In addition, 64% of the patients presented with post-inflammatory hyperpigmentation[13].

However, case series and comparative tests using the 1410-, 1540-, and 1550-nm non-ablative fractional lasers (NAFL) of showed a greater improvement in the appearance of the striae, and among these lasers, the authors recommend the 1540-nm NAFL for the treatment of stretch marks. A series of comparative cases have investigated treatment with 1540- and 1410-nm NAFL and reported significant clinical improvement when the two laser systems were used[14], and the 1540-nm NAFL caused an even greater improvement in the striae than the 1410-nm NAFL[14].

Another case series has reported a 1%-24% improvement in the appearance of stretch marks after four monthly sessions of 1540-nm NAFL in terms of stria aspect, whereas two case series on striae treatment with 1540-nm Er:Glass laser showed improvement in stretch marks after two to four sessions[15-17]. Four case series and one case report have shown a significant improvement in stretch marks after three to eight sessions using a 1550-nm Erbium NAFL[18-21]. Moreover, several cases have presented good clinical improvement in up to 75% of the treated striae, and most striae showed improvement in texture and color[22].

Based on the promising results of comparative studies and case reports on NAFL, future research should consider conducting large-scale randomized clinical trials to determine and establish the safety and efficacy of NAFLs and to recommend such therapy for stretch marks.

Ablative Lasers

10600-nm CO_2 Laser

Ablative lasers are effective in treating scarring as they cause ablation in the epidermal layer and can penetrate deep into the dermis. Ablation and tissue coagulation stimulate neocollagenesis and elastin deposition during healing. However, treating patients with darker skin requires caution as they are at increased risk of developing post-inflammatory hyperpigmentation. This review found three randomized studies and two case series that used ablative CO_2 laser.

A randomized clinical trial treated 22 patients with CO_2 laser and 1550-nm Er:glass non-ablative fractional laser and reported a significant reduction in the length and width of the stretch marks[23]. Three treatments with either the 10600-nm ablative CO_2 laser (40-50 mJ, spot density of 75-100 spot/cm^2) or 1550-nm non-ablative fractional laser (50 mJ, 100 spot density of 100 spot/cm^2) were conducted at 4-week intervals.

Another randomized clinical trial involving six patients has investigated the improvement of stretch marks after treatment with a 10,600-nm fractional CO_2 laser compared to glycolic acid[24]. The mean decrease in surface area and the mean improvement score were both higher in the group treated with CO_2 laser than in the group treated with glycolic acid[24].

A randomized comparative trial has revealed significant improvement with only 5 sessions of fractionated CO_2 laser treatment compared to 10 sessions of intense pulsed light after 5 months, as assessed by an evaluator who did not participate in the applications of the lasers and by measuring the width of the stretch marks[3]. A different comparative randomized clinical trial has reported that treatment with fractional CO_2 laser combined with PDL resulted

in a significantly greater improvement compared to treatment with isolated fractional CO_2 laser[25].

Two case series showed excellent improvement in stretch marks in terms of aesthetics after treatment with ablative CO_2 laser. The first case series showed a 75%-100%, 50%-75%, 25%-50%, and 0%-25% improvement in 7.4% (2 of 27), 51% (14 of 27), 3.3% (9 of 27), and 7.4% (2 of 27) patients, respectively[26]. Post-inflammatory hyperpigmentation occurred in few patients (number not defined) and resolved within 4 weeks[26].

The second case series has investigated atelocollagen succinylate combined with CO_2 ablative laser for stretch marks and reported improved striae with such treatment[27]. The treatment of stretch marks with CO_2 ablative laser showed promising clinical improvements in randomized trials and observational studies, and future research should include randomized clinical trials with larger sample size to develop protocols for laser configurations to maximize positive outcomes and minimize risks, such as post-inflammatory hyperpigmentation.

2940-nm Erbium:YAG Laser

Only one case report has shown that patients prefer the cosmetic results of the 2940-nm Er:YAG ablative laser to those of PDL[28].

After conducting this review, a combined treatment with PDL and NAFL for striae rubra and treatment with NAFL for striae alba is recommended. Most red pigments in striae rubra are absorbed by the pulsed dye laser or other vascular lasers. The appearance and texture of the stretch marks can improve significantly with 1540-nm NAFL.

Due to the appearance of microthermal zones and the capability to stimulate collagen growth, ablative and non-ablative fractional lasers can become a promising therapy for the treatment of stretch marks since they aid in the remodeling of the extracellular matrix, including collagen and elastin[14,29]. The increase in the amount of reorganized, remodeled, normalized, and healthy elastin fibers in the dermis was associated with the clinical improvement in the appearance of stretch marks[30,31].

Recent studies have shown that non-ablative fractional laser can obtain better results in treatment of stretch marks, in addition to recovery being earlier than with ablative lasers. In relation to these reasons, the 1540-nm non-ablative fractional laser showed interesting therapeutic modality as a front-line treatment of stretch marks. However, larger studies must be conducted to standardize doses and protocols.

Future studies should focus on improving study design, including a larger sample size, a randomized long-term comparative study with objective outcome measures, such as skin biopsy results, and molecular studies showing increased collagen and elastin fibers correlating to clinical improvements.

CONCLUSION

The prevention and treatment of stretch marks remain a clinical challenge as evidence by the different alternative methods that are available. Limitations include the few randomized clinical trials that have evaluated the long-term efficacy and safety of the different treatment modalities using universally validated standardized assessment methods.

Non-ablative fractional lasers, particularly 1540-nm lasers, are interesting therapies for the stretch marks.

COLLABORATIONS

ACN Analysis and/or interpretation of data; statistical analysis; final approval of the manuscript; data collection; study design; project management; research; methodology; writing: preparation of the manuscript; writing: revision and editing; supervision; validation; and visualization.

LCS Analysis and/or interpretation of data; final approval of the manuscript; data collection; investigation; writing: preparation of the original; writing: revision and editing; validation; and visualization.

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***Corresponding author:** **André Coelho Nepomuceno**
Av. Dr. José Bonifácio Coutinho Nogueira, nº 214, Sala 435 - Jd. Madalena - Campinas, SP, Brazil
Zip Code 13.091-611
E-mail: andreconep@yahoo.com.br