

Intense Pulsed Light in the treatment of scars caused by burns

Luz Intensa Pulsada no tratamento de cicatrizes após queimaduras

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ABSTRACT

Introduction: Scars caused by burns have the potential to cause clinical, social, and functional disruptions. Dermatologists should be able to intervene in this process by combining technological advances with traditional techniques.

Objective: To evaluate the effect of Intense Pulsed Light applications on scars after burns, based on clinical parameters described in the international Vancouver Scar Scale.

Methods: A prospective study was carried out with six patients who underwent five monthly Intense Pulsed Light sessions over the entire area of a wound. The analysis of the results was conducted by three evaluation groups: 3 physician researchers, the patients included in the study, and 3 physician observers. The evaluation was implemented using the Vancouver Scale, a questionnaire based on this scale, and additionally a general rating used by all evaluators based on a numerical scale. The data obtained by examining the differences before and after the treatment, was analyzed through the Wilcoxon signed-rank test.

Results: A statistically significant decrease was observed in the analyses of all clinical parameters of the scars, when evaluated before and after the completion of the treatment.

Conclusions: The present pilot study demonstrates the advantages of Intense Pulsed Light as an approach to this specific type of scar, with an aim of stimulating further studies in order to improve this low-cost technology, as compared to lasers.

Keywords: lasers; intense pulsed light therapy; cicatrix; burns.

RESUMO

Introdução: Cicatrizes após queimaduras têm potencial de causar transtorno clínico, social e funcional. O dermatologista deve estar apto a intervir nesse processo aliando o avanço tecnológico às técnicas tradicionais.

Objetivo: avaliar a resposta da Luz Intensa Pulsada (LIP) em cicatrizes após queimaduras baseada em parâmetros clínicos descritos na escala internacional de Vancouver para cicatrizes.

Métodos: estudo prospectivo com seis pacientes que foram submetidos a cinco sessões mensais de LIP (Luz Intensa Pulsada) sobre toda área de cicatriz. A análise dos resultados foi obtida a partir de três grupos de avaliação compostos por: três médicos pesquisadores, os pacientes incluídos no estudo e três médicos observadores através da escala de Vancouver e de um questionário nela baseado, além de uma nota geral em escala numérica respondida por todos os avaliadores. A variação de antes para depois do tratamento dos dados obtidos foi analisada pelo teste dos postos sinalizados de Wilcoxon.

Resultados: observou-se queda estatística significativa nas análises de todos os parâmetros clínicos avaliados das cicatrizes antes e após término do tratamento.

Conclusões: nosso trabalho representa um estudo piloto que demonstra as vantagens da LIP na abordagem deste tipo de cicatriz e que visa estimular estudos complementares para aprimoramento dessa tecnologia de baixo custo se comparada aos lasers.

Palavras-chave: lasers; terapia de luz pulsada intensa; cicatriz; queimaduras.

INTRODUCTION

Scars resulting from burns have the potential to cause significant disruption to bearers due to their often disfiguring clinical appearance, to the entailed functional impairment, and to the social embarrassment they produce. The approach to treating scars includes several therapeutic options, such as pressure therapy, intralesional corticosteroid therapy, cryotherapy, silicones, topical treatments, and surgical corrections. These techniques—combined or not—nevertheless have limited results, especially regarding the clinical appearance of scars.

Laser therapy has emerged as a therapeutic option for approaching scars. Published studies from the 1970s have highlighted that analysis of characteristics of the scar area, such as texture, thickness and color, constituted decisive parameters in pre-laser treatment evaluation. The improvement of this technique occurred *pari passu* to the development of the treatment of atrophic scars using ablative (CO₂ and Erbium:YAG) and non-ablative (1,320nm Nd:YAG) lasers and, more recently, fractional lasers. In the literature, the use of laser therapy for hypertrophic scars is conflicting and despite the gradual replacement of the Argon, 1,064nm Nd:YAG and 10,640nm CO₂ lasers for the 585nm and 595nm Pulsed Dye Laser (PDL) with promising results, further studies with a greater degree of evidence are still necessary.¹⁻¹⁰

In the present study, intense pulsed light (IPL) is used as a therapeutic option in the approach to scars caused by burns. Although there are publications suggesting the use of IPL as a therapeutic option in the approach of hypertrophic and keloid scars, its use for the treatment of scars after burns still remains unexplored and discussions about its indication for this purpose remain scarce.^{1,2,4}

OBJECTIVE

To evaluate the response of IPL on scars after burns, based on the clinical parameters described in the international Vancouver scale used to assess scars.^{11,12}

METHODS

A prospective study was conducted from March 2012 to March 2013, at the Cosmetic Dermatology ambulatory of the Instituto de Dermatologia Prof. Rubem David Azulay, Santa Casa de Misericórdia do Rio de Janeiro, with the approval of the Medical Ethics Committee of the institution. Six patients of both genders (4 women and 1 man), with ages between 21 and 48 years (mean = 33 years), with varied distribution of phototypes according to the Fitzpatrick classification (Table 1), who showed scarring from thermal burns which had occurred more than six months before and who had undergone prior conventional treatment in centers for treatment of burns, and who were not under ongoing topical treatment at the time of the study, were included in the present research.

The exclusion criteria in the selection of patients included: contraindications to the use of IPL, pregnancy or lactation, presence of symptoms of pain, burning and/or itching in the scar area, use of oral retinoids in the previous six months, and use of medication that induced photosensitivity in the previous three months.

After the evaluation of the above criteria, all patients were informed of the study's objectives and were enrolled in the project according to their interest in participating. All participants read and signed a free and informed term of consent. Photographic records were always carried out in the same room and with the same photographic background, preferably by the same researcher physician, with a Nikon Cool Pix P100 (26x Zoom) camera, before and after the treatment. (Figures 1 to 7)

Patients underwent five IPL sessions at monthly intervals over the entire area of the scar using a Lip Sq tip (Square-wave Pulse system), which features an integrated cooling system through a sapphire tip, with 540nm cutoff filter from the Etherea® platform (Industra Technologies, São Carlos, SP, Brazil).

Before each session, the target area was cleansed with a lotion with no alcohol and without the prior use of a topical

TABLE 1: Patients' age, gender, and phototype. Fluence and average pulse duration/session. Scar's site

PATIENT	AGE (years)	GENDER	PHOTOTYPE	FLUENCE (J/cm ²)	PULSE DURATION (ms)	SITE
A	21	female	IV	12~15	12	Perioral
B	28	female	II	12~13	20	Upper limbs
C	32	female	II	16~18	10~20	Dorsum and upper limbs
D	36	male	IV	12~13	20	Upper limbs
E	48	female	II	14~16	10~20	Breast
F	28	female	II	12~13	20	Breast



FIGURE 1: Patient A –pre- and post



FIGURE 4: Patient D –pre- and post



FIGURE 2: Patient B - left upper limb, pre- and post



FIGURE 5: Patient E –pre- and post



FIGURE 3: Patient C –pre- and post



FIGURE 6: Patient D - detail of the right hand dorsum, pre- and post

anesthetic. The parameters used in each session were defined according to the patient's tolerance regarding discomfort, with the data being recalculated according to the clinical results obtained in previous sessions. The fluence used was 12-18 J/cm² (mean =14.6 J/cm²) and the pulse duration was 10 or 20 ms. (Table 1). The results were analyzed by three groups of evaluators: three researcher physicians, the patients included in the study, and three observer physicians. The first two groups carried out evaluations before and three months after the end of the study, while the third group carried out its assessment based on photographic material taken before and after treatment.

The clinical course of the scars was assessed by a group of evaluators through the international Vancouver scale for scars, which includes flexibility, vascularization (degree of erythema), relief and color (melanin pigmentation). (Table 2) In order to facilitate the patients' self-assessment, five questions were formulated with possible answers based on numerical scales derived from the clinical criteria or the Vancouver scale. Also, an overall rating, ranging from 0 (excellent) to 10 (very bad), was used by the three evaluation groups to grade the overall assessment of the scar.

The descriptive analysis presented the observed data



FIGURE 7: Before and after IPL

(expressed as median, minimum, and maximum) in the form of tables.

The before-and-after variation—assessed through a questionnaire, the Vancouver scale, and a numerical scale—was analyzed through of the Wilcoxon signed-rank test. The criterion determining the significance was set at 5%, i.e. when the p-value was less than or equal to 0.05, there would be no statistical significance.

The statistical analysis was performed with assistance of the SAS 6.11 software (SAS Institute, Inc., Cary, North Carolina, USA).

All patients selected completed the study, having answered the questionnaire before and after the treatment with an aim at verifying whether there was significant variation in the criteria assessed by the questionnaire (based on the Vancouver scale for scars). Similarly, the study aimed at validating the presence of a significant variation in the data obtained on that scale (ac-

ding to the researcher physicians) and on the numerical scale (according to the patients, researcher physicians, and observer physicians).

The variables assessed by the Vancouver scale were originally measured in an ordinal scale, i.e. a gradation with qualitative interpretation. However, the reduced sample size ($n = 6$), prevented the processing of appropriate statistical methods. Therefore, the present study proposed an exploratory analysis of the data from a numerical point of view, aiming mainly at the impact of the treatment after five monthly IPL sessions. Table 3 provides the median (minimum–maximum) rating of the Vancouver scale according to three researcher physicians (RP1, RP2, and RP3) at times before and after the treatment and the corresponding descriptive level (p-value) of the statistical test.

Statistical analysis was performed through the Wilcoxon signed-rank test.

The patient self-evaluation before and after the treatment showed a significant decrease (at the 5% level) in the evaluation of all aspects of the questionnaire. That statistical validation translates the clinical improvement seen in all parameters observed by the patients after the treatment, such as dyschromias, hypertrophy, and flexibility of the scarred area, using criteria based on the Vancouver scale.

According to the researcher physicians, the ratings of the Vancouver scale for scars showed significant decrease (at the 5% level) before and after the treatment, except for the variable pigmentation, which had initially showed little expression, as shown in table 3 and graph 1.

The assessment done according to the numerical scale and corresponding to the overall rating attributed to the three evaluation groups before and after the treatment, presented a significant reduction (at the level of 5%) for all evaluators.

Regarding adverse effects, all patients had erythema and slight, tolerable discomfort during the sessions, with no need for any specific treatment. Burning sensation for a few hours after the session was reported by two patients, however without leading to changes in the schedule of the treatment. One patient had blisters after the 4th session, resolving without sequelae.

DISCUSSION

The introduction of laser therapy has emerged as a new tool in the therapeutic approach to scars. Based on the principle of selective photothermolysis, which acts on specific chromophores, it enabled a more specific approach to the assessment of parameters prevailing in each lesion, such as variation in color, pliability and relief.^{1-4, 6, 8, 13-6}

The broad spectrum of the IPL's light beam (from 515nm to 1,200nm) allows exertion on the different chromophores present in scars—such as the hemoglobin present in the neovascularization of the intense cicatricial tissue and the melanin resulting from the stimulus of melanogenesis—enabling the treatment of the erythema and the dyschromia, respectively. Another effect of IPL described in studies on its use in photo-rejuvenation is the possible induction of collagen remodeling through the photo-stimulation of the fibroblasts and metallo-

TABLE 2: International Vancouver Scar Scale

Relief (height)	0	Normal
	1	<2mm
	2	2-5mm
	3	>5mm
Vascularization	0	Normal
	1	Pink
	2	Red
	3	Purple
Pigmentation	0	Normal
	1	Hypopigmented
	2	Mixed
	3	Hyperpigmented
Plicability	0	Normal
	1	Supple
	2	Yielding
	3	Firm
	4	Banding
	5	Contracture

TABLE 3: Vancouver Scar Scale evaluation according to researcher physicians (RP), before and after the treatment

Vancouver Scale	Before			After			p-value*
	Med	Min	Max	Med	Min	Max	
Pliability – RP1	2	1	- 3	0,5	0	- 1	0,023
Pliability – RP2	3	2	- 4	1	0	- 1	0,026
Pliability – RP3	3	2	- 5	1	0	- 1	0,027
Relief – RP1	1,5	1	- 3	0,5	0	- 1	0,020
Relief – RP2	2	1	- 2	1	1	- 1	0,025
Relief – RP3	2	1	- 3	1	0	- 1	0,023
Vascularization – RP1	2	0	- 3	1	0	- 2	0,034
Vascularization – RP2	2	1	- 3	1	1	- 1	0,034
Vascularization – RP3	2	1	- 3	1	0	- 1	0,020
Pigmentation – RP1	0	0	- 3	0	0	- 2	0,32
Pigmentation – MP2	1	0	- 2	0,5	0	- 2	0,32
Pigmentation – MP3	1	0	- 3	0,5	0	- 2	0,16
Overall rating – MP1	5,5	4	- 10	2,5	0	- 5	0,026
Overall rating – MP2	7	6	- 10	3,5	2	- 5	0,027
Overall rating – MP3	7,5	6	- 13	3	2	- 5	0,027

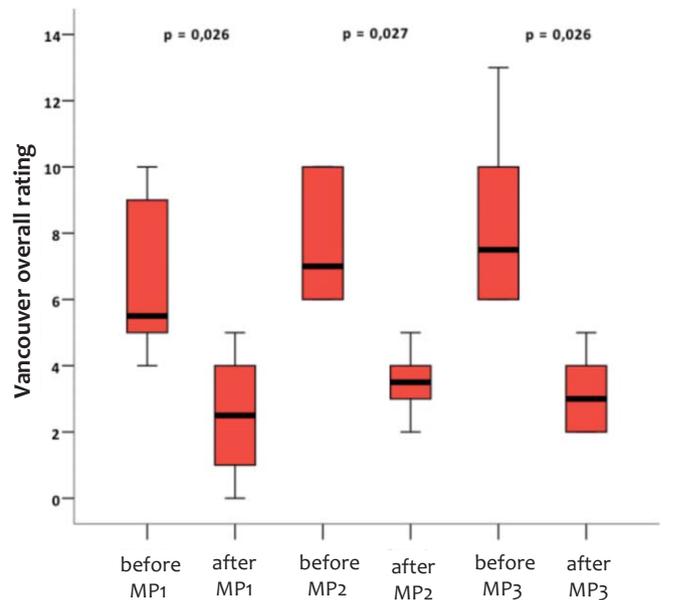
med: median; min: minimum value observed; max: maximum value observed

* Wilcoxon signed-rank test

proteinases of the dermal matrix.¹⁷⁻²⁴

In the literature, there are few studies aimed at evaluating the use of IPL on scars, more specifically after burns. Its use for hypertrophic or keloid scars, isolatedly or comparatively to laser therapy, was described by Bellew et al., who approached hypertrophic scars with PDL and IPL, finding improvements in the appearance of scars with both techniques, without demonstrating superiority of one over the other. In 2008, Erol et al. treated 109 patients with IPL—the scars had different etiologies, with 19 patients suffering from thermal injury. The results presented demonstrated improvement of those scars regarding dyschromia, relief, pliability and texture of the scar tissue, through clinical and photographic parameters. More recently, Isaac et al., aiming at determining safety standards and evaluating the degree of satisfaction and local complications after each session, demonstrated the use of IPL in hyperchromic scars after burns that had occurred more than two years before in 19 patients between 9 and 62 years of age, with IPL phototypes II–V. After 9 monthly sessions it was statistically demonstrated that there was an improvement in the level of patients' and observer physicians' satisfaction, in addition to the existence of a direct correlation between the degree of improvement and the number of sessions undergone.

Although recent studies have demonstrated benefits in the use of laser therapy in the early treatment of scars caused by elective procedures, the ideal time to start the therapeutic procedures remains unclear. Bellew et al. demonstrated clinical improvement of post-mammoplasty and abdominoplasty early



GRAPH 1: Researcher physicians (RP) overall-rating according to the Vancouver Scar Scale, before and after the treatment

hypertrophic scars using PDL and IPL in the proliferative phase of formation of the scar tissue (6–8 weeks after the injury was caused).^{25, 26}

The use of IPL during the study proved to provide clinical improvement in all parameters evaluated, such as dyschromias, pliability, and reduction of hypertrophic areas. The impro-

vement of hypertrophic scarring in all cases treated is noteworthy. Regarding dyschromias, the response was more significant in erythemas as compared to the brown color of scars. Despite the fact that hypochromic areas were not included in the rating scales of scars, no improvement was observed in this parameter. It was possible to gradually increase the intensity of treatment parameters, such as fluence and pulse duration—and to be initially more conservative when compared to those used for photorejuvenation—without adding significant side effects.

In the present study, the authors chose to focus on the approach to scarring caused by burns that had happened over six months before. However it is also possible to compare the use of IPL in earlier stages of scar proliferation in further studies. Its use in the initial phase would be an attempt to reduce the formation of hypertrophic scars, which translates clinically into relief alterations (dystrophic) caused by the imbalance in the synthesis and degradation of collagen present in the wound healing process.

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CONCLUSION

In the authors' opinion, IPL is able to combine important characteristics, which suggests that this technique can be made available for patients with scars caused by burns. IPL technology is a technology familiar to dermatologists, it is cost-effective when compared to other laser sources, and has been demonstrated to provide satisfactory clinical improvement—evaluated both objectively and subjectively—for the treated scars that were caused by burns. In this context, the present study represents a pilot study carried out in the authors' dermatologic service aimed at demonstrating both the benefits of IPL in treating this type of scar and stimulating further studies with more accurate assessment methods in order to create a protocol for the approach of patients affected by burns or bearing scars. ●