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Case Report

New Insight in Noninvasive Rejuvenation: The Role of a Rhodamine-Intense Pulsed Light System

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Abstract

Background: Rhodamine-intense pulsed light (r-IPL) is a noncoherent, noncollimated, polychromatic light energy optimized for a double-peak wavelength emission, ranging between 550–680 and 850–1200 nm. Traditional IPL works within visible and infrared spectra, targeting hemoglobin and melanin, are effective to treat rosacea and pigmentary disorders. r-IPL, a new technology in dermatology, emits high-intensity light with a wavelength peak similar to the one of the pulsed dye lasers, showing a good safety and efficacy profile in nonablative photorejuvenation.
Objective: Assess efficacy and safety of r-IPL on photodamaged facial skin showing hyperpigmentation, telangiectasias, fine lines, and textural changes.
Methods: Five sessions of r-IPL treatment (fluence ranged between 13.5 and 14 J/cm^2) have been performed on one 75-year-old lady affected by facial photodamaged skin. Efficacy of treatment was evaluated using the Fitzpatrick Elastosis and Wrinkles Scale (FEWS) and the Global Aesthetic Improvement (GAI) Scale assessed by an investigator, compared with baseline. Treatment safety and tolerance were also evaluated using the Visual Analog Scale (VAS).
Results: Photographic and multispectral evaluation demonstrated relevant improvement (vascular, pigment, and texture) of photodamaged facial skin. One month after the last treatment, significant improvement in facial wrinkle and texture was noted. FEWS scores decreased significantly from 7 to 2. According to the GAI scale, the patient had an improvement in skin texture. Immediate response included mild-to-moderate erythema and only trace-mild edema in the treatment area. Pain during the treatment was minimal with a mean VAS pain score of 3/10. No other adverse events were reported. No post-treatment downtime was recorded.
Conclusions: r-IPL may represent a valid therapeutic approach in noninvasive photorejuvenation.

Keywords: rhodamine, intense pulsed light, skin aging

Introduction

Rhodamine intense pulsed light (r-IPL) is a novel noncoherent, noncollimated, polychromatic light optimized for a double-peak wavelength emission ranging between 550–680 and 850–1200 nm, respectively. This novel pulsed light source shares clinical properties with pulsed dye laser (PDL) systems. Effective treatments of vascular lesions, benign pigmented lesions, and textural changes due to photodamage have been reported recently.[1,2]

This novel technology specifically absorbs rhodamine, a liquid fluorescent substance, and is different from conventional IPL systems, is capable of recycling energy instead of losing it,[1] and focuses on the vascular narrow range of 550–680 nm (optimized for 595 nm dye laser wavelength). The 850–1200 nm range works with the same properties of a standard IPL.

r-IPL acts with a maximum fluence of 25 J/cm^2, and a pulse duration ranging from 3 to 24 ms. Epidermal cooling is provided by a handpiece. r-IPL uses the same IPL physical and chemical principle, benefiting from its technology and endpoints.

Traditional IPL works within visible and infrared spectra action, targeting hemoglobin and melanin, with greatest efficacy pigment disorders and skin texture, according to certain authors.

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FIG. 1. Chrono- and photoaging of the face before r-IPL treatment. r-IPL, rhodamine intense pulsed light.

Traditional IPLs side effects, linked to wide absorption targets (hemoglobin and melanin), include purple bruises and transient hyperpigmentation that may last up to 2 weeks.[3,4] Gitte F. Jogersen described the efficacy of PDL and IPL on photodamaged skin, and in this report, PDL was found to be more effective than IPL.[5] r-IPL shares a wavelength peak emission with PDL, showing for this reason a potential therapeutic application for a wide range of photodamage signs, hitting vascular pigmentary targets and further inducing improvement of textural changes in aging skin. Notably, this light is able to increase collagen formation inducing fibroblast activation and dermal remodeling process related to thermal damage.[6,7]

Piccolo et al. published recently a comparative study between traditional IPL and r-IPL to evaluate the efficacy, safety, and superiority of the new r-IPL for its vessel-specific wavelength. In this study, side effects occurred more commonly after standard IPL sessions compared with r-IPL.[1] Moreover, patients included in the r-IPL group did not refer any side effects, such as intense erythema or slight crusting; therefore, these authors decided to use higher fluences and increased number of passes, achieving marked results with reduced sessions.

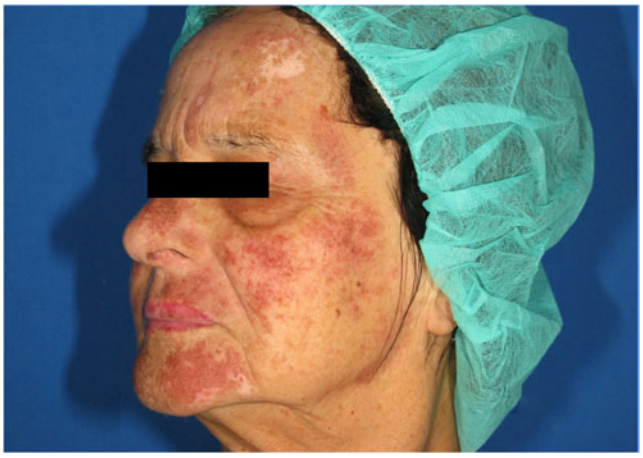

FIG. 2. Clinical image of the face immediately after r-IPL procedure.

FIG. 3. Results after five r-IPL sessions.

Therefore, r-IPL could represent a valid alternative tool for noninvasive photorejuvenation, without common side effects and discomfort induced by traditional IPL.

Patient and Methods

We report the case of a 75-year-old woman who presented marked signs of photoaging, including spot-pigmented lesions, diffuse melanin pigmentation, telangiectasias, widening of pores, elastotic skin, and fine wrinkles (Fig. 1). Patient was treated with r-IPL for facial skin rejuvenation.

Written informed consent and photographic images for scientific purposes have been achieved.

Exclusion criteria for treatment, such as history for skin cancer, use of photosensitive drugs, and light-induced immunological diseases, have been considered before treatment.

Evaluation of the results was taken at baseline, 12, and 24 weeks after treatment using a digital camera system, Anthology (DEKA M.E.L.A., Florence, Italy), and a multisource three-dimensional (3D) mapping skin surface spectrum photographic device, Antera 3D (Miravex Ltd., Dublin, Ireland), able to analyze hemoglobin and melanin skin components.

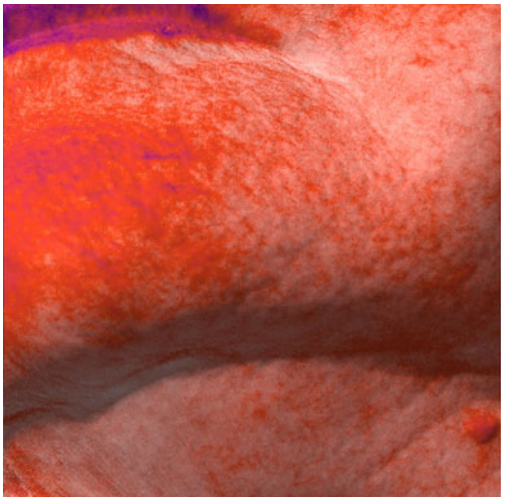

FIG. 4. Multispectral image of vascular tissue before r-IPL treatment.

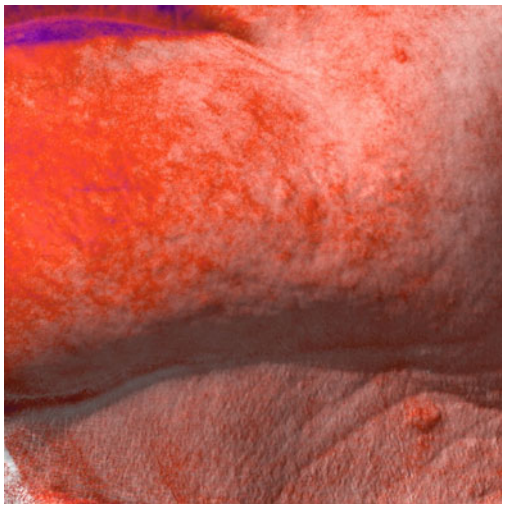

FIG. 5. Multispectral image of vascular tissue after r-IPL treatment.

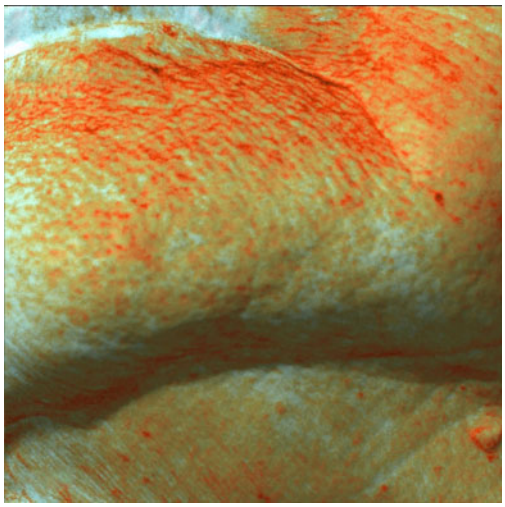

FIG. 7. Multispectral image of melanin after r-IPL treatment.

Patient underwent r-IPL (DEKA M.E.L.A) treatment with a fluence of 13.5 J/cm^2; fluence was then increased to 14 J/cm^2 in the following sessions. A double-pulse duration of 6–8 ms, with a delay of 10 ms between pulses, was performed. Treatment included a session every 15 days for a total of five sessions. Conductive cold gel for IPL was located between crystal and light to provide optimal contact and heat dispersion. Patient well tolerated the treatment and no side effects were reported. Immediately after treatment, photographs were taken (Figs. 2–7).

Efficacy of treatment was evaluated using the Fitzpatrick Elastosis and Wrinkles Scale (FEWS)[8] and the Global Aesthetic Improvement (GAI)[9] Scale, assessed by an investigator, compared with baseline. Treatment safety and tolerance were also evaluated using the Visual Analog Scale (VAS).

Lamp Features

r-IPL is a new pulsed-light system, optimized for wavelengths ranging between 550 and 650 nm, that can achieve performances comparable with 595 nm PDLs (Fig. 8). The r-IPL handpiece uses rhodamine as a fluorescent substance that can absorb wavelengths in the UV spectrum up to 550 nm and re-emit fluorescence light at 550 and 650 nm, with a rhodamine peak at ~570 nm, without losing energy during the transformation (Fig. 9).

This system shifts emission bands via fluorescence. Also, UV spectrum wavelengths are emitted from fluorescence (in the range between 450 and 500 nm). This range of wavelengths would not produce therapeutic effects on the vascular targets, but may interact with the pigmentary targets such as melanin. Traditional IPL systems cut off these wavelengths through filters. The r-IPL technology does not eliminate energy, but rather transfers it to a vascular frequency range, within the dye laser range, to increase both energy efficiency and performance on the hemoglobin chromophore (Fig. 10).

The second emission that ranges between 850 and 1200 nm emitted simultaneously 550–680 nm, and increases fibroblast proliferation and activity, which can be a possible mechanism of action for aging skin treatment.[10]

Features of the lamp used are summarized in Table 1.

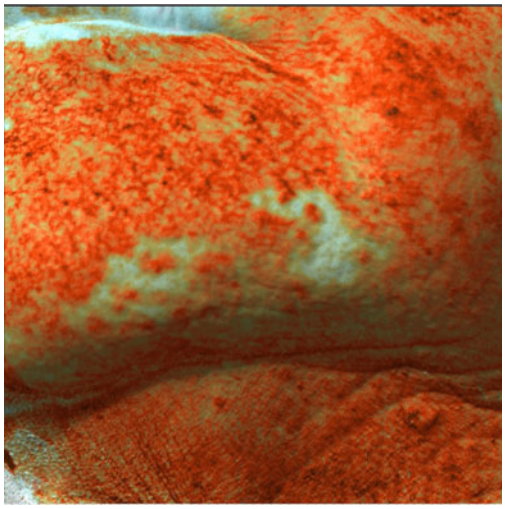

FIG. 6. Multispectral image of melanin before r-IPL treatment.

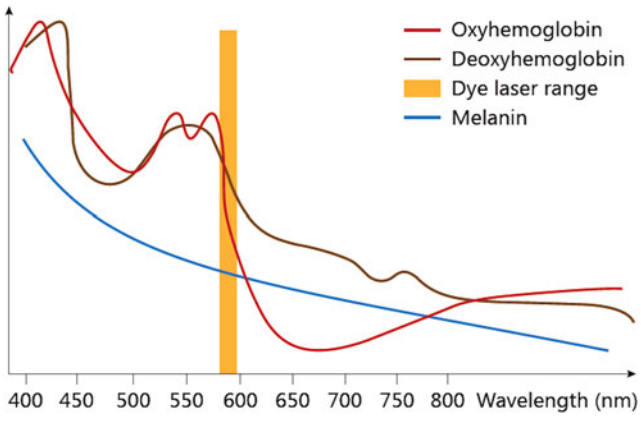

FIG. 8. Absorption spectrum of the main skin chromophores and hemoglobin selectivity of the dye laser.

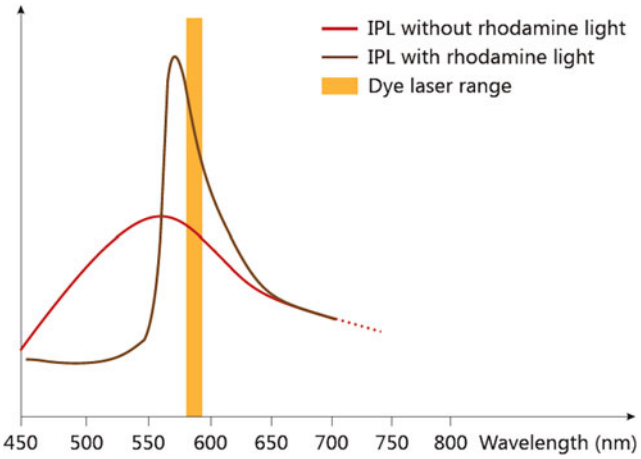

FIG. 9. Emission frequencies of IPL, rhodamine light, and dye laser.

Results

Photographic and multispectral evaluation demonstrated relevant improvement (vascular, pigment, and texture) of photodamaged facial skin. One month after the last treatment, significant improvement in facial wrinkle and texture was noted. FEWS scores decreased significantly from an initial score of 7 to 2. According to the GAI Scale, the patient had a marked improvement in skin texture in comparison with baseline.

Pigmentation and textural improvement was observed after r-IPL treatment (Fig. 3), also confirmed by multispectral analysis (Figs. 4–7). Atrophic lesions showed improvement as well.

Immediate response included mild-to-moderate erythema and only trace-mild edema in the treatment area.

Pain during the treatment was minimal with a VAS pain score of 3/10. No other adverse events were reported. No post-treatment downtime was recorded.

Discussion

IPLs are high-intensity light sources using high-output flashlamps to produce a broad wavelength output of noncoherent light, usually ranging from 500 to 1200 nm.[11,12]

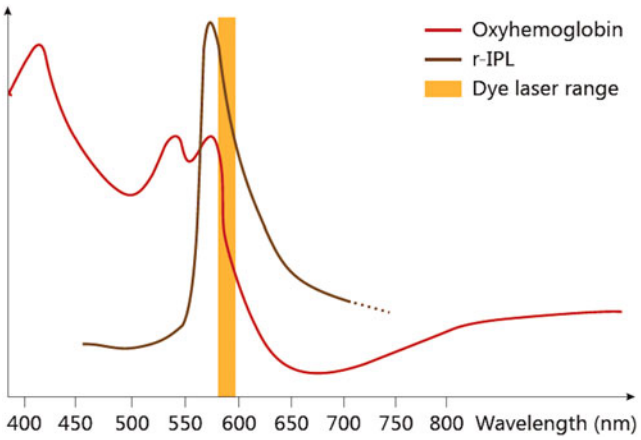

FIG. 10. Increase in vascular performance of r-IPL on the hemoglobin chromophore.

Table 1. Lamp Parameters

Lamp type: xenon lamp immersed in rhodamine
Wavelength: 550–680 and 850–1200 nm.
Max fluences: 25 J/cm^2
Treatment surface: 48 × 13 mm
Number of pulses:1–3
Pulse duration: 2–20 ms (single pulse); 9–66 (double pulse);16–124 ms (triple pulse)
Skin cooling sapphire temperature: 8°C–18°C

Rhodamine-based devices use a fluorescent substance that absorbs wavelengths in UV and visible spectrum, releasing them again in fluorescence with a range between 550–650 and 850–1200 nm, with a rhodamine peak of 570 nm.

Rhodamine could therefore represent an active filter that is able to recycle energy instead of losing it, unlike IPL conventional filters.[12] Lasers aim to hit vascular chromophores such as oxyhemoglobin, typically showing three absorption peaks, respectively, at 418, 542, and 577 nm wavelengths. PDL and IPL systems specifically hit endogenous chromophores such as hemoglobin and melanin, resulting in vessel clearance and reduction of dyschromia due to the concept of selective photothermolysis.[13] Efficacy of PDL and IPL for sun-damaged skin has previously been described in different clinical trials, showing excellent results with vessel clearance and pigment reduction.[14] Gitte F. Jogersen described the efficacy of PDL and IPL from rejuvenation, finding PDL to be more effective than IPL.[5]

r-IPL shares PDL wavelengths and targets all the visible features of aging skin, including fine lines, telangiectasias, and irregular pigmentation, with a lower rate of adverse effects.

As shown in this case, different aspects of photoaging significantly improved after r-IPL treatment, in accordance with recent studies.[1,7]

Notably, no significant side effects (such as crusting or scars) have been reported and the treatment scheme was very comfortable (one session every 15 days for five times), despite a transient mild-to-moderate erythema. These minor side effects after r-IPL treatment appear less significant than postlaser treatment signs.[4]

Conclusions

r-IPL induced a marked improvement of both the pigmentary and vascular components. This was evaluated after digital photography and multispectral analysis; skin texture results improved in terms of reduction in fine lines, pore size, and luminosity. Treatment was overall well tolerated, with no significant side effects. Clinical outcome was satisfactory with excellent patient compliance.

Future controlled studies on a large number of cases are required to further assess the efficacy of r-IPL in the treatment of photodamaged facial skin. In our opinion, r-IPL, due to its safety and specificity for pigmentary and vascular targets, should be considered a valid noninvasive photorejuvenation treatment.

Author Disclosure Statement

Authors and coauthors declare no financial or personal conflict of interest in this research. The manuscript has not

been published previously. All authors and contributors have read and approved the manuscript.

References

1. Piccolo D, Crisman G, Kostaki D, et al. Rhodamine intense pulsed light versus conventional intense pulsed light for facial telangiectasias. J Cosm Laser Ther 2014;18:80–85.
2. González-Rodríguez AJ, Lorente-Gual R. Current indications and new applications of intense pulsed light. Actas Dermosifiliogr 2015;106:350–364.
3. Goldberg DJ. Current trends in intense pulsed light. J Clin Aesthet Dermatol 2012;5:45–53.
4. Jørgensen G, Hedelund L, Haedersdal M. Long-pulsed dye laser versus intense pulsed light for photodamaged skin: a randomized split-face trial with blinded response evaluation. Lasers Surg Med 2008;40:293–299.
5. Nelson JS, Majaron B, Kelly KM. What is no ablative photo rejuvenation of human skin? Semin Cutan Med Surg 2002;21:238–250.
6. Orringer JS, Voorhees J, Hamilton T, et al. Dermal matrix remodelling after no ablative laser therapy. Acad Dermatol 2005;53:777–782.
7. Campolmi P, Cannarozzo G, Dragoni F, Conti R, Moretti S. Efficacy of rhodamine light in the treatment of superficial vascular lesions of the face. Med Princ Pract 2016;25:477–482.
8. Lemperle G, Holmes R, Cohen S, Lemperle S. A classification of facia wrinkles. Plast Reconstr Surg 2001;108: 1735–1750.
9. Carruthers A, Carruthers J. A validated facial grading scale: the future of facial ageing measurement tools? J Cosm Laser Ther 2010;12:235–241.
10. Cuerda-Galindo E, Díaz-Gil, Palomar-Gallego MA, Linares-GarcíaValdecasas R. Increased fibroblast proliferation and activity after applying intense pulsed light 800–1200 nm. Ann Anat 2015;198:66–72.
11. Schoenewolf NL, Barysch MJ, Dummer R. Intense pulsed light. Curr Probl Dermatol 2011;42:166–172.
12. Kono T, Groff W, Sakurai H, et al. Comparison study of intense pulsed light versus a long-pulse pulsed dye laser in the treatment of facial skin rejuvenation. Ann Plast Surg 2007;59:479–483.
13. Nelson JS, Majaron B, Kelly KM. What is no ablative photo rejuvenation of human skin? Semin Cutan Med Surg 2002;21:238–250.
14. Uebelhoer NS, Bogle MA, Stewart B, Arndt KA, Dover JS. A split-face comparison study of pulsed 532-nm KTP laser and 595-nm pulsed dye laser in the treatment of facial telangiectasias and diffuse telangiectasia facial erythema. Dermatol Surg 2007;33:441–448.

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