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Treatment of Melasma and the Use of Intense Pulsed Light: A Review

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ABSTRACT

Melasma is a complex multifactorial disorder whose pathogenesis is not well understood. In addition to increased pigmentation, increased vascularity associated with pigmentation is present. A variety of topical treatments targeting pigmentation are available with temporary improvement of mainly the epidermal components of melasma. Intense pulsed light (IPL) is a broadband light source that can target a wide range of cutaneous structures, including deeper pigmentation and vasculature. We describe 5 cases of persistent facial melasma treated with the IPL and a hydroquinone-based skin care system (Obagi Nu-Derm; Obagi Medical Products, Long Beach, CA), showing improvement of facial melasma pigmentation and vascularity.

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INTRODUCTION

Melasma is a complex multifactorial disorder whose pathogenesis is not well understood. In addition to increased superficial and/or deep pigmentation, increased vascularity is often present. Vascular endothelial growth factor (VEGF) is an angiogenic factor demonstrated within melasma patches that is a likely cause of the increased vasculature. Interactions between melanocytes and the cutaneous vasculature may influence the development of pigmentation. Topical treatments targeting pigmentation are available with temporary improvement of mainly the epidermal component of melasma.[1] Intense pulsed light (IPL) is a broadband light source that can target a wide range of cutaneous structures, including deeper pigmentation and the increased vasculature. With a lower side effect profile compared with other devices used to treat melasma, IPL is a good potential treatment option for dermal and mixed forms of melasma.[2] We describe 5 cases of persistent facial melasma treated with IPL and a hydroquinone (HQ)-based skin care system (Obagi Nu-Derm; Obagi Medical Products, Long Beach, CA), showing improvement of facial melasma pigmentation and vascularity.

CASE REPORTS

Case 1

A 45-year-old Hispanic female presented with facial melasma and was started on the Obagi Nu-Derm System, which includes HQ, α-hydroxy and β-hydroxy acids, cleanser, and toner used twice daily, a sunscreen with a sun protection factor of 30+ in the daytime, and tretinoin cream 0.025% nightly (Figure 1a-c). One month later, she was treated with IPL using a 590-nm filter amd a double-pulse technique with 3-ms pulse duration, 40-ms delay, and a fluence of 14 J/cm^2. Cold-air cooling was used intraoperatively. The Obagi Nu-Derm system was restarted and continued for 5 months until the patient's follow-up visit, which demonstrated clinical improvement of her melasma (Figure 1d-f).

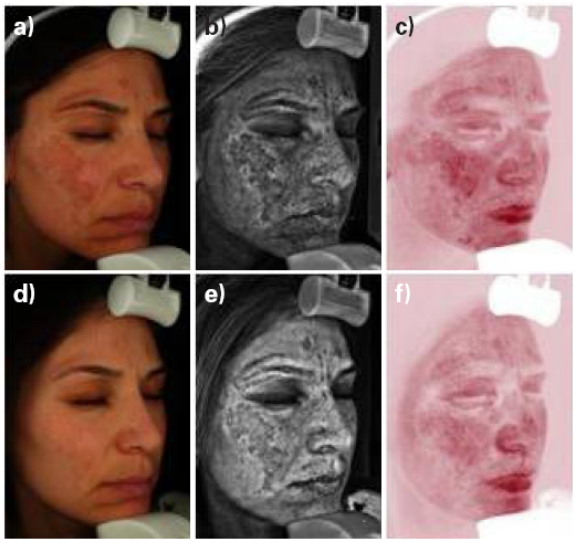
Case 2

A 42-year-old Asian woman presented with a several-year history of facial melasma (Figure 2a-c). Intense pulsed light was used with a 590-nm filter and a double-pulse technique with 3-ms pulse duration, 40-ms delay, and a fluence of 17 J/cm^2. Cold-air cooling was used intraoperatively. She was instructed to immediately start the Obagi Nu-Derm System. She developed mild erythema on postoperative day 6 that resolved with fluocinolone acetonide cream 0.025% twice daily for a week and a light-emitting diode (LED) photomodulation treatment (Gentle Waves; Light BioScience, LLC, Virginia Beach, VA). At the 1-month follow-up visit, clinical improvement of her melasma was demonstrated (Figure 2d-f).

Case 3

A 35-year-old Hispanic woman presented with a several-year history of facial melasma (Figure 3a-c). She underwent 2 IPL treatments spaced 6 weeks apart. A double-pulse technique with 3-ms pulse duration for both pulses was used, with a 560-nm filter, 30-ms delay, and a fluence of 17 J/cm^2 for the first treatment and 18 J/cm^2 for the second treatment. Cold-air cooling was used intraoperatively. She was then instructed to start the Obagi Nu-Derm System after her second IPL treatment. At the 6-month follow-up visit following the last IPL treatment, clinical improvement of her melasma was demonstrated (Figure 3d-f).

FIGURE 1. a) Patient 1 before treatment, demonstrating brown patches over cheeks and forehead consistent with melasma. **b)** VISIA Complexion Analysis accentuating brown patches of melasma under ultraviolet (UV) filter. **c)** VISIA complexion analysis highlighting increased vascularity corresponding to melasma patches. **d)** Lightening of melasma patches after 6 months on the Obagi Nu-Derm System (Obagi Medical Products, Long Beach, CA) and 1 intense pulsed light (IPL) treatment. **e)** A decrease in brown melasma patches under the UV filter after 6 months on the Obagi Nu-Derm System and 1 IPL treatment. **f)** A decrease in vascularity corresponding to melasma patches after 6 months on the Obagi Nu-Derm System and 1 IPL treatment.



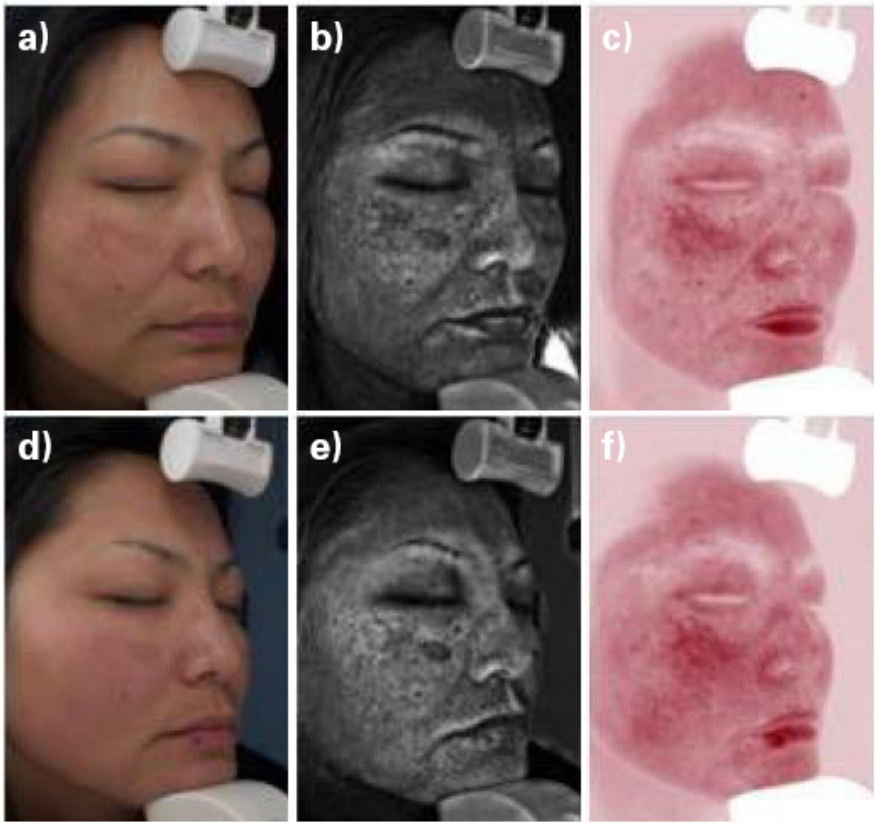
Case 4

A 35-year-old Hispanic woman presented with a 2-year history of facial melasma. She elected to first start with the Obagi Nu-Derm topical lightening system. After 8 months of use, she underwent 1 IPL treatment using a double-pulse technique with 3-ms pulse duration for both pulses, with a 560-nm filter, 30-ms delay, and a fluence of 18 J/cm^2. Cold-air cooling was used intraoperatively. She was then instructed to continue using the Obagi Nu-Derm system. At the 1-month follow-up visit following the IPL treatment, clinical improvement of her melasma was demonstrated.

Case 5

A 33-year-old Hispanic woman presented with a several-year history of facial melasma. At the time of presentation, she was on the Obagi Nu-Derm system. She underwent 3 IPL treatments spaced 3 and 4 months apart. A double-pulse technique with 3-ms pulse duration was used, with a 560-nm filter, 20-ms delay, and a fluence of 17 J/cm^2 for all 3 treatments. Cold-air cooling was used intraoperatively. She was instructed to continue on the Obagi Nu-Derm system. At the 6-month follow-up visit following the last IPL treatment, clinical improvement of her melasma was demonstrated.

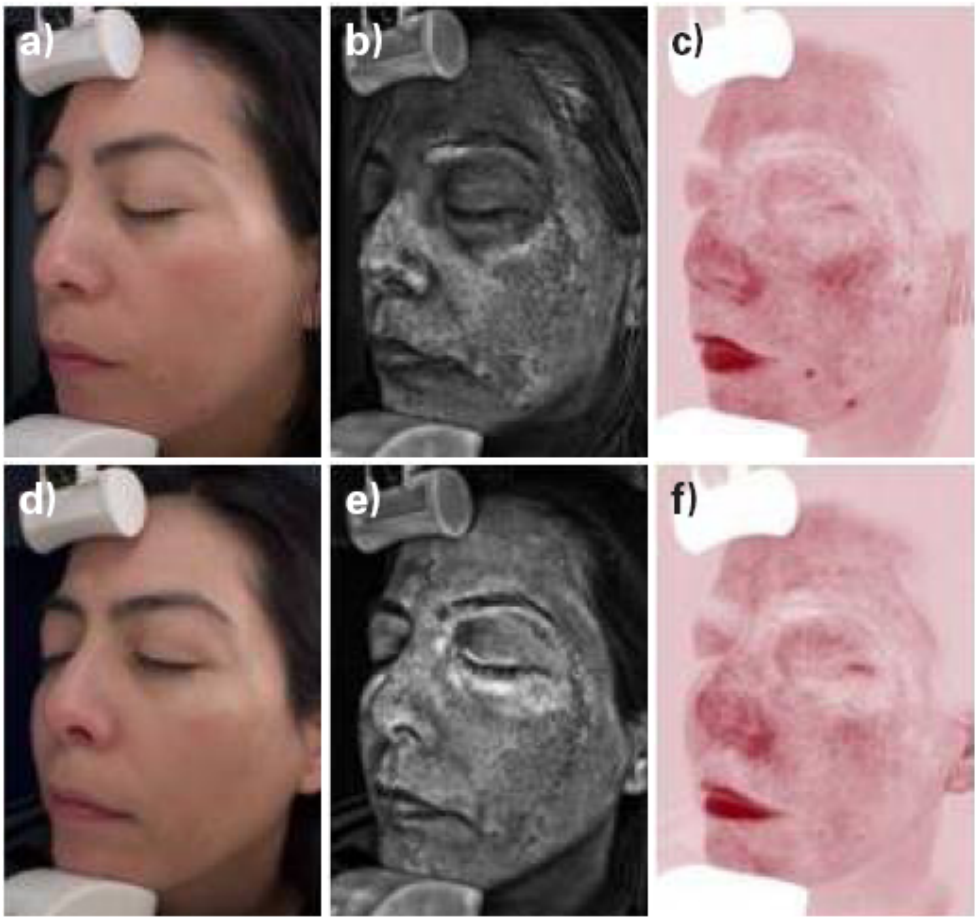
FIGURE 2. a) Patient 2 before treatment, demonstrating brown patches over cheeks consistent with melasma. **b)** VISIA Complexion Analysis accentuating brown patches of melasma under ultraviolet (UV) filter. **c)** VISIA Complexion Analysis highlighting increased vascularity corresponding to melasma patches. **d)** Lightening of melasma patches after 1 intense pulsed light (IPL) treatment and 1 month on the Obagi Nu-Derm System (Obagi Medical Products, Long Beach, CA). **e)** A decrease in brown melasma patches under the UV filter after 1 IPL treatment and 1 month on the Obagi Nu-Derm System. **f)** A decrease in vascularity corresponding to melasma patches after 1 IPL treatment and 1 month on the Obagi Nu-Derm System.



DISCUSSION

Melasma is an acquired disorder of hyperpigmented macules or patches on sun-exposed areas of the body. Risk factors include a genetic predisposition, sun exposure, stress, medications, and pregnancy. Three types of melasma exist, with increased amounts of melanin, melanocytes, and melanosomes within the epidermis, dermis, or a mix of the two.[3] A bimodal age response has been reported, with improved treatment response in patients younger than 35 years and older than 45 years. This is thought to be due to hormonal effects and increased dermal melasma in patients aged 35 to 45 years.[4] Traditional therapies are more effective for epidermal melasma and include sunscreens, depigmenting agents, mild topical corticosteroids, tretinoin, and chemical peels.[3] Intense pulsed light and various lasers have also been used, including the quality (Q)-switched ruby (694 nm), Q-switched neodymium- doped yttrium aluminum garnet (Nd:YAG; 1,064 nm), diode (840 nm), pulsed dye laser (595 nm), nonablative fractionated 1,550-nm erbium (Er)-doped laser, 2,940-nm Er:YAG with dermabrasion, and combined ultrapulsed CO_2 laser with Q-switched alexandrite (755 nm).[4-7]

FIGURE 3. a) Patient 3 before treatment, demonstrating brown patches over cheeks and forehead consistent with melasma. **b)** VISIA Complexion Analysis accentuating brown patches of melasma under ultraviolet (UV) filter. **c)** VISIA Complexion Analysis highlighting increased vascularity corresponding to melasma patches. **d)** Lightening of melasma patches after 2 intense pulsed light (IPL) treatments 6 months apart with concurrent use of the Obagi Nu-Derm System (Obagi Medical Products, Long Beach, CA). **e)** A decrease in brown melasma patches under the UV filter after 2 IPL treatments 6 months apart with concurrent use of the Obagi Nu-Derm System. **f)** A decrease in vascularity corresponding to melasma patches after 2 IPL treatments 6 months apart with concurrent use of the Obagi Nu-Derm System.



The pathogenesis of melasma is important when considering laser treatment. Kim et al[1] reported increased vascularity as a major finding in melasma with increased amounts of VEGF and blood vessels within melasma lesional skin. It has been postulated that ultraviolet (UV) radiation-induced dermal inflammation activates fibroblasts and stem cell factors in melasma dermal skin, causing melanogenesis. The increased vascularity could be why melasma occurs in select regions and not uniformly across the face, despite equal UV damage.

Vascular endothelial growth factor has also been shown to stimulate the release of arachidonic acid, and the metabolites of this pathway may affect melanogenesis. Steroids in triple-agent creams used to treat melasma can also induce telangiectasias, possibly exacerbating this component of melasma.[1] Bak et al[8] reported increased nerve growth factor and neural endopeptidase in melasma lesional skin, also suggesting its association in the pathogenesis of melasma.

Multiple studies have shown varied effectiveness of lasers in the treatment of melasma. The nonablative 1,550-nm fractional laser has been used to treat melasma with greater patient satisfaction 3 weeks after treatment compared with topical triple-agent therapy of HQ 5%, tretinoin 0.05%, and triamcinolone acetonide 0.1% cream. It was thought the laser brought greater satisfaction early on because of a faster initial clearance and a possible increased effectiveness in treating dermal melasma. However, 6 months posttreatment, the pigmentation returned in both treatment groups with equal patient satisfaction rates. Side effects of the 1,550-nm laser treatment included erythema, burning sensation, edema, and pain. Kroon et al[6] noted no postinflammatory hyperpigmentation (PIH) with this treatment modality using conservative settings.

Wind et al[9] described the use of the nonablative 1,550-nm fractional laser in the treatment of melasma, and 9 patients (31%) developed PIH after 2 or more laser sessions. The increased PIH seen in the study is likely secondary to more aggressive treatment settings. Skin findings and side effects associated with topical triple-agent therapy included erythema, scale, and burning. Triple-agent topical therapy is still the treatment of choice because of similar efficacies 6 months posttreatment.[10-11]

The Q-switched Nd:YAG laser has also been reported to temporarily improve melasma with common complications, including hypopigmentation, melasma recurrence, and rebound hyperpigmentation. Transient erythema, transient burning, and slight edema occurred for 1 hour postprocedure. Wattanakrai et al[12] found decreased epidermal and dermal pigmentation for up to 1 year after 10 weekly treatments with the Q-switched Nd:YAG laser at subthreshold photothermolytic fluencies (<5 J/cm^2). However, rebound hyperpigmentation was common, and the risk of mottled hypopigmented macules increased with greater number of laser sessions.[12,13] Narrowband UVB has successfully been used to treat depigmentation with good clinical results.[13] The short-pulsed deep Er:YAG laser temporarily but effectively reduces epidermal type melasma, with a recurrence upon discontinuation of treatment.[14]

A review of the literature suggests that laser and light source treatments can result in rebound hyperpigmentation, relapse, and darkening of melasma. It has been postulated that the laser unmasks a previous subclinical melasma. This is thought to be secondary to stimulation of hyperactive melanocytes, which can increase melanin production and therefore pigmentation.[15]

Intense pulsed light is a noncoherent filtered flashlamp light source, emitting light between 515 and 1,200 nm. Filters allow for selective photothermolysis of chromophores, including melanin and hemoglobin.[5,16] Since its introduction in 1992, there are now more than 20 different IPL devices available worldwide.[17] Each IPL device has a unique set of wavelengths, fluences, pulse durations, epidermal temperature effects, and other pulse parameters in addition to duration, such as unifor-

mity of the pulse delivery. Intense pulsed light has been used to treat melasma, telangiectasias, spider nevi, rosacea, lentigines, postburn hyperpigmentation, erythrosis, poikiloderma of Civatte, photoinduced skin aging and to reduce hair.[2,18]The IPL activates fibroblasts, resulting in the synthesis of new collagen with wrinkle reduction, increased skin elasticity, contraction of larger pores, reduction of brown spots, and a decrease in telangiectasias.[19] Side effects of IPL include a transient erythema and slight edema that resolve within 12 hours, PIH, and desquamating microcrusts for 7 to 10 days.[3] The major problem in evaluating the peer-reviewed medical literature is that each IPL device has a unique set of parameters that makes it different from the others. Thus, when reviewing the IPL literature, the improvement and complication profile may not be 100% reproducible from one IPL device to another. Our experience, and most of the published literature, is with the Lumenis IPL systems (Santa Clara, CA), but even within one company, the IPL systems differ based

on the model.

"We feel that IPL is the light source of choice for the treatment of dermal and mixed melasma because of its lower side effect profile and ability to target both melanin and hemoglobin as chromophores."

Intense pulsed light has multiple advantages over other lasers for the treatment of melasma. The longer wavelengths used with IPL allow deeper penetration for treatment of dermal melasma. The larger spot allows for more extensive areas of the face to be treated in a shorter time period, minimizing patient discomfort. There is also a decrease in nonhomogeneous resolution with a decrease in polka-dot treatment results with the IPL that can be seen with smaller laser round-spot sizes. In addition, there are fewer local or systemic effects because of the pulse delays in more advanced IPL systems, so the skin can be cooled between pulses.[2] This decrease in photothermal injury leads to less PIH in comparison with Q-switched lasers.[5]

The IPL has been used in combination with the Q-switched ruby laser, with 19/25 (76%) of patients reporting good to excellent responses.[20] Side effects mainly included PIH in 12% and linear hypopigmentation in 4%. The IPL was advantageous because of the minimal preoperative preparation, easy application, limited posttreatment care, and a lack of downtime. However, multiple treatments are often needed to obtain the desired results, and deeper-pigmented patches tend to be less responsive. The addition of the Q-switched ruby laser allows for deeper penetration of dermal melasma but a higher risk of PIH. Repeated IPL treatments could decrease PIH caused by the Q-switched laser. The pulse duration of IPL is in milliseconds, resulting in a greater thermal diffusion and a more generalized destruction of pigment. Quality-switched lasers are in a nanosecond range, which selectively targets melanosomes with decreased thermal diffusion.[20]

Poikiloderma of Civatte is similar to melasma, as both conditions involve hemoglobin and melanin as chromophores targeted with treatment. Goldman and Weiss reported a 50% to 75% clearance of telangiectasias and hyperpigmentation in poikiloderma with an average of 2.8 IPL treatments. There was a 5% incidence of mild pigmentary side effects. Improvement in skin texture was an added bonus with the IPL treatments.[18,21]

The successful use of IPL for skin rejuvenation has been well documented in the literature.[17,22-24] Nootheti et al found a 40% improvement in photoaging after a single IPL treatment.[25] Feng et al found an 84.6% pigmentation improvement and an 81.25% telangiectasia improvement after 3 IPL treatments.[26] However, JØrgensen et al[27] found the long-pulsed dye laser to be advantageous over the IPL in photodamaged skin because of superior vessel clearance and less pain associated with the procedure. Both the laser and IPL had similar efficacy with pigmentation clearance.[27]

Repigmentation with melasma eventually recurs, likely secondary to persistent triggering factors.[5] We feel that IPL is the light source of choice for the treatment of dermal and mixed melasma because of its lower side effect profile and ability to target both melanin and hemoglobin as chromophores.[17,21] Targeting the vascular component of melasma in addition to the pigmentation may be the key to improved results.

Our melasma patients demonstrate a strong correlation of vascularity with their melasma on the VISIA Complexion Analysis (VISIA, Fairfield, NJ). Currently, triple-agent therapy is the firstline treatment for melasma. The VISIA Complexion Analysis may be an easy method to determine which patients are the best candidates for concurrent IPL therapy.

DISCLOSURES

Drs. Zaleski and Fabi have no conflict of interest to declare. Mitchel P. Goldman MD is a stockholder and consultant to Lumenis Ltd. and a consultant to Obagi Medical Products, Inc.

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