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Helios III: Indian Experience with Avantgarde Innovative Fractional Q-Switched ND: YAG Laser

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Abstract

Laser toning using low-fluence 1064-nm QSNY is being increasingly used to target photoaging and hyperpigmentation in darker skin types. However, sub-optimal response stemming from the use of low-fluences, as well as development of complications especially punctate leukoderma are also being increasingly reported with this approach. Since the development of the fractional- lasers, the fractional mode has been successfully incorporated with QS Nd:YAG (QSNY) laser (1064 nm) systems. Fractional mode lasers have the advantage of sparing certain areas in between the treated areas called microscopic treatment zones (MTZs), allowing for rapid healing, shorter recovery times, and less post-inflammatory complications. In this case series, we report our experience of a novel US-FDA approved fractional QSNY laser device Helios III in the treatment of various cutaneous lesions disorders in Indian patients including melanocytic nevi, atrophic scars, pigmented scars, laser hair reduction, reduction of white hair, melasma, and toe nail onychomycosis.

Keywords: Fractional Laser; Q-Switched; Nd:YAG; 1024 NM; Scars; Melasma; Hair Reduction.

Introduction

The field of laser medicine and surgery has evolved a great deal over the past few years. Aesthetic devices are attaining more and more versatility, whether by virtue of multi-platform devices or the new innovative approach of laser devices with highly flexible and tunable parameters that enable catering to varied cutaneous and aesthetic needs. The Q-switched (QS) lasers, especially QS neodymium-doped yttrium aluminium laser (QSNY) 1064 nm have a long record of proven efficacy and safety in different skin disorders, especially pigmentary disorders like melasma and other facial melanosis, and tattoo removal. Although laser toning using low-fluence 1064-nm QSNY has gained popularity in the treatment of photoaging and hyperpigmentation in darker skin types, there are multiple reports of sub-optimal response (typically due to use of very low fluences to prevent complications) as well as post-laser dyschromias especially punctate leukoderma [1,2].

Since the development of the fractional-mode of delivery of laser energy, in recent years, the fractional mode has been successfully incorporated with QS Nd:YAG laser (1064 nm) systems. Fractional mode lasers have the advantage of sparing certain areas in between the treated areas called microscopic treatment zones (MTZs), allowing for rapid healing, shorter recovery times, and less post-inflammatory complications [3].The fractional mode in QSNY allows use of low fluence that actually delivers a much higher energy through each treatment hole enhancing the spot efficacy, but also spatially spares intervening areas that provides a much lesser down time and minimal possibility of complications, which were typically encountered with non-fractional low-fluence laser toning.

About the Technology

Helios III [Figure 1] is the latest innovative fractional" QSNY laser from Korea. The Helios III laser system is based on the Nd:YAG (1064 nm) and frequency doubled KTP Nd:YAG (532 nm) laser

Fig. 1: The Helios III device

technology. The three basic elements of its operations include – (a) Nd:YAG crystal used as a gain medium, which produces a laser beam, (b) a resonator then amplifies the beam, and (c) a lamp that contains Xenon gas that is used as a pumping light source [4]. The regulation of laser output and repetition rate can be set by the user via GUI (Graphic User Interface) and controlled by microprocessor, which interfaces with the power supply.

It has been documented to be very effective for skin rejuvenation, lightening superficial and deep pigmentation and various other aesthetic indications. The color sensitive laser beam targets only the pigmented lesion in the skin, sparing the normal surrounding tissue. In its patented 4G laser-toning mode, Helios III has the added benefit of stimulating collagen remodeling to bring about skin radiance, reducing skin vascularity and erythema. This innovative fractional QSNY is capable of reducing acne inflammation, exfoliating clogged pores and reducing pore size. Thus, it can effectively treat melasma, freckles, tattoos, post-inflammatory hyperpigmentation (PIH), photoaging, acne, rosacea, atrophic scars and hirsutism. The device has minimal down time and can be used for therapeutic aesthetic purposes (correction of a pigmentary/textural/photoaging-related cosmetic deformity) as well as a regular "laser-facial" for maintenance of general skin health and beauty.

Helios III has five modes and four hand-pieces. It fractional handpiece was developed with diffractive optical element (DOE), a new patented technology that releases micro beams (instead of the erstwhile bulk beams of energy) that stimulate keratinocytes minimally thereby minimizing the possibility of PIH.

Statutory Licensing of the Device

In view of the plethora of devices with similar indications being manufactured by unreliable companies, the importance of the statutory approval of a device by the United States Food & Drug Administration (US-FDA) need not be overemphasized. *Laseroptek Co. Ltd.*, the manufacturers of Helios III, was accorded US-FDA approval from the Department of Health & Human Services in June 2016 [4]; the indications for which Helios III was given approval are listed in Box 1.

Box 1: US-FDA approved indications for Helios III device [4]

- Tattoo removal (dark ink – blue & black)
- Tattoo removal (light ink – red, sky blue, green)
- Dermal pigmented lesions e.g. Nevus of Ota, Café au lait birthmarks, solar lentigenes, senile lentiginos, becker's nevi, freckles, and nevus spilus
- Removal or lightening of hair with or without adjuvant preparation
- Incision, excision, ablation & vaporization of soft tissue for general dermatological purposes
- Treatment of vascular lesions: port wine, birthmarks, telangiectasias, spider angioma, cherry angioma, and spider nevi

Results with Helios III in Indian Patients

The device has been approved by the US-FDA and has been extensively used with high efficacy and safety in the lighter skin types. The purpose of this paper is to apprise Indian Dermatologists, and dermatologists using laser devices in the skin of color (SOC) with the first-hand experience of the authors of using the device in Indian patients for various indications.

Ablative Indication-Congenital Melanocytic Nevus

For ablation and excision of soft tissue lesions like congenital melanocytic nevi [Figure 2], we used the fractional handpiece with a small spot size. The procedure was performed under topical anesthesia.

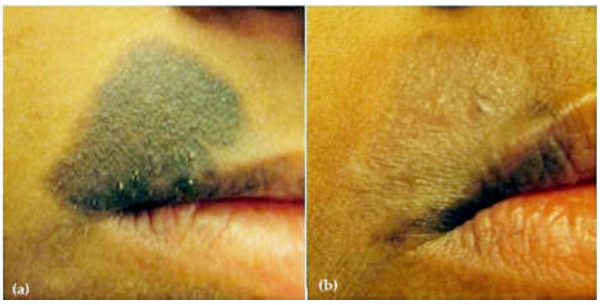

Fig. 2: Large facial congenital melanocytic nevus (a) before treatment, (b) 4 weeks after a single session of treatment done in the ablative mode. Note the minimal scarring and an overall excellent cosmetic outcome

Melasma

Laser intervention in the treatment of melasma has always been controversial. Laser toning with QSNL, intense pulsed light (IPL), fractional lasers and combination of lasers have yielded variable outcome in different trials conducted in Asian patients with melasma [5-7]. The sequential pathogenesis of melasma involves many steps. After synthesis by the Raper-Mason pathway, the melanin pigment is packed into melanosomes in the melanocytes, which are then transferred to keratinocytes through cell-cell interaction involving the cellular dendritic processes [8]. The fractional QSNY laser Helios III interferes via its photoacoustic effect by inducing 'laser dendrectomy', preventing the melanosomal transfer to the keratinocytes. The heating of the melanosome generates steam that appears as clinical whitening of the lesion accompanied with erythema, which also serve as the end-point in most cases. We have obtained best results in Indian patient of melasma by using the zoom handpiece in nanosecond pulse, and the fractional handpiece in real twin pulse (RTP) mode [Figure 3].

Fig. 3: Multiple coalescing macules of treatment refractory melasma in a young Indian lady (a) before treatment with Helios III, (b) 12 weeks after two sessions of treatment with fractional Q-switched Nd:YAG done in nano-second mode with zoom handpiece.

Atrophic & Pigmented Scars

The treatment of atrophic scars in SOC suffers from the limitation of the possibility of post-laser PIH [9]. If the scar is already hyperpigmented, the problem gets further compounded. However, this potential complication has been rendered very unlikely by employing the Neogenesis, Quasi Long Pulse Mode of Helios III QSNY device that utilizes the microsecond pulse instead of the nanosecond pulse, resulting in effective dermal neocollagenesis and collagen remodeling [Figure 4]. Further, by using different spot sizes, the device can treat linear as well as odd-shaped scars. For linear scars, we use the zoom handpiece in fractional mode and weekly sittings are undertaken. Our preferred parameters are – spot size varying from 3-5, energy between 1,400-1,500 Joules, and density upto 7 Joules/cm^2.

The fractional handpiece of the Helios III QSNY has been developed with DOE patented technology that releases micro beams (instead of bulk beams of energy). This results in minimal keratinocyte stimulation thereby minimizing the possibility of PIH. The nanosecond mode with the zoom and fractional handpiece, with a pulse width of 8 is very safe and ideal to treat pigmented scars [Figure 5].

Fig. 4: Multiple brown-colored post varicella box-like facial scars on the face of an Indian lady (a) before treatment with Helios III, (b) 12 weeks after two sessions of treatment with fractional Q-switched Nd:YAG done in quasi long-pulsed

Fig. 5: Post-traumatic irregular hyperpigmented scars over the cheek of a young Indian lady (a) before treatment, (b) 2 months after two sessions of treatment with Helios III using the zoom handpiece in nano-second pulse mode and a pulse width of 8.

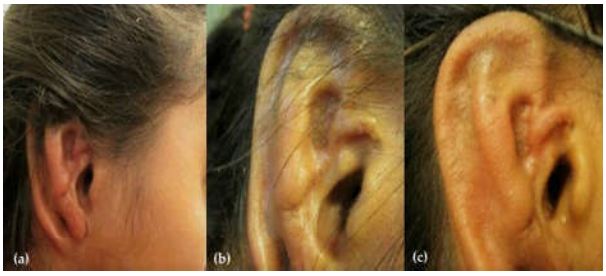

Fig. 6: Cosmetically unacceptable hypertrichoss over and around the ear-lobes of a young Indian lady (a) before treatment, (b) after two sessions of treatment with Helios III in quasi long-pulse mode, and (c) after six sessions of treatment with Helios III in quasi long-pulse mode.

Hair Reduction

While using the Helios III device for routine hair reduction, we have achieved excellent results with the QS Nd:YAG fractionated mode with a spot size of 2-3 [Figure 6]. We use the neogenesis quasi long pulse mode for this purpose.

White Hair Reduction

The target chromophore for laser hair reduction is the melanin present in the hair follicular isthmus. That is why, it is extremely difficult to reduce or destroy grey and white hair by conventional lasers used for reduction of pigmented hair. Different techniques have been tried in the past to remove grey-white hair by using dyes/products to stain the grey-white hair follicle followed by laser. In a randomized, controlled, double-blind study evaluating melanin-encapsulated liposomes as a chromophore for laser hair removal of non-pigmented hair, 42 areas of blond, gray, or white facial and body hair of 16 patients and 16 controls were treated with a liposomal melanin spray and physiological saline spray respectively and 3 cycles of 800 nm diode laser at intervals of 8 weeks [10].

Although, the melanin-encapsulated liposomal spray in combination with diode laser treatment showed significantly higher efficacy in the treatment of white and blond hair compared with the control group, the clinically observed hair reduction was minimally appreciable. Further, the high cost of the melanin formulation was another factor against the employment of this technique [10].

Contrastingly, in another randomized, double-blind controlled study, photodynamic hair removal using rose bengal-encapsulated liposomal gel in combination with IPL treatment showed significant efficacy in the treatment of white hair compared with a control group [11]. But there is paucity of trials on laser reduction of non-pigmented hair, and the available trials have yielded modest outcome at best.

Fig. 7: Predominantly white beard hair of a 63-year old Indian adult man (a) before treatment, (b) after six sessions with Helios III using the carbon atom dye followed by QS Nd: YAG laser

The Helios III QSNY device is unique, and possibly one of the pioneering platforms that allows successful reduction of even grey to white hair. The carbon atom dye is utilized before shooting the QS Nd:YAG laser energy. The carbon atom percolates to the level of the hair follicular isthmus acting as an external chromatophore, substituting for the lack of hair follicular melanin, the usual target of laser hair reduction. We have been using this device successfully in the reduction of grey hairs employing the carbon atom dye technique [Figure 7].

Toe Nail Onychomycosis

In recent times, both fractional ablative lasers and QS lasers have been successfully used as innovative treatment modalities for toe nail onychomycosis. Laser has been used as a stand-alone therapy as well as in combination with topical and/or oral antifungals [12-14]. The 1024 nm long-pulsed Nd:YAG laser has been found highly efficacious in this regard [13,14].

The Helios III QSNY laser utilizes the principle of multi-layered bulk heating of the fungus-infected nail plate and matrix, thereby providing fungicidal effect

Fig. 8: Multiple toe nail onychomycosis in a 55-year old Indian adult with cardiac failure (a) before treatment, (b) 6 months after a combination therapy with three sessions of treatment with Helios III and weekly topical amrolfine nail lacquer without any oral anti-fungals

as well as enhancing the subsequent penetration of topical antifungal lacquers. The procedure is painful. For laser treatment of onychomycosis of toe nails, the fractional and zoom hand-pieces are used. This approach is useful for patients who are intolerant or otherwise non-candidates for oral antifungals and/or surgical nail avulsion [Figure 8].

Frequency of Laser Sessions with Helios III

The treatment parameters of energy, density, spot size etc. are dependent on the lesion being treated and its attributes such as the depth and shape of scar, depth of pigmentation, density and thickness of hairs etc. Patients, by and large require 4-8 treatment sessions which may be conducted once in a week, 2-weekly, 3-weekly or 4-weekly. Post-treatment care is akin to that of any other standard laser device and includes meticulous sun-protection and moisturization.

Conclusion

The fractional QSNY laser device Helios III is a highly versatile platform that offers high efficacy and excellent safety in Indian patients, i.e. patients with darker skin types. It treats scars of various depths and configuration without the risk of PIH. Hyperpigmented disorders like melasma are effectively treated with minimal down time and high safety. Apart from its other uses like ablation of nevi, treatment of onychomycosis, this device also offers effective laser hair reduction. Helios III can provide effective hair reduction in difficult-to-treat areas like the ear lobes (where diode laser tip is almost inaccessible). Further, using this device in combination with carbon atom dye also provides the unique option of laser hair reduction of grey-white hair, which is almost non-achievable by any other technology at present. The knowledge of its various handpieces, parameters, and operation is essential to deliver the best results to patients with minimal to nil downtime and high level of safety.

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