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REVIEW

Treating Melasma with Sub-Thermolytic Q-Switched Nd:YAG

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ABSTRACT

The successful treatment of melasma by sub-thermolytic Q-Switched Nd:YAG laser therapy has been demonstrated by several investigators. The minimization of side-effects and reoccurence in high phototype patients is a major topic of current research. The approaches taken and the results obtained are reviewed in this paper.

Key words: melasma, Q-switched Nd:YAG

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I. INTRODUCTION

Sub-thermolytic (sometimes referred to also as sub-ablative) Q-Switched Nd:YAG laser therapy is becoming common for skin rejuvenation and the treatment of various skin imperfections, among them Melasma. This treatment modality has proven to be especially popular in the Asian world.

Melasma is a difficult to treat condition with a high rate of reoccurence. Current first line therapies include topicals such as hydroquinone and arbutin. Some investigators have found sub-thermolytic Q-Switched Nd:YAG laser therapy to be a safe and effective in the treatment of Melasma [1-2], while others have found more mixed results because of the rate of reoccurence after therapy [3].

Three types of Melasma are recognized: dermal, epidermal and mixed. Epidermal Melasma is relatively easy to treat; its relatively superficial location leaves it open to a wide number of treatment startegies [3]. Dermal and mixed melasma are harder to treat, the effected cells lie deeper in the dermis and cannot be reached as easily. Using low-fluence Q-switched treatment a practitioner can expect complete clearing in 50% of cases of epidermal melasma, and between 30-50% of cases of dermal or mixed melasma [2]. The balance of patients will in most cases achieve partial clearance, and a small precentage will be non-responders. A major concern of treatment is the minimization of melasma reoccurence and side effects. Often laser therapy is paired with, or preceded by, topical hydroquinone therapy in an attempt to enhance and maintain results.

II. BACKGROUND

In brief, the biochemical chain of events which leads to melasma is as follows. Specific melanocyte clones become hyperactive. UV light stimulates the release of epidermal cytokines. Cytokines stimulate tyrosinase, a critical enzyme in melanin synthesis. The stimulation of tyrosinase leads melanosomes to over produce melanin. The Melanin is transferred to keratinocytes where it collects [2]. Many variations on this basic pattern are possible. In roughly 2/3 of cases of melasma melanophages are found in the upper dermis. This is the result of melanophages "dropping" through the damaged membrane between the dermis and epidermis.

All common treatments of melasma fall into four broad categories: the reduction of melanin synthesis (often through the inhibition of tyrosinase), the increase of melanin transfer and shedding, skin resurfacing, and pigment selective lasers.

Nd:YAG, frequency doubled Nd:YAG, Ruby and Alexandrite [4] Q-switched lasers have been used to treat skin pigments, both natural and artificial, for many years and are the standard of care for birthmarks, solar lentigines, and tattoo removal. A Q-switched pulse is over so quickly (it has such a small pulse duration) that extremely small pigments 10-100 nm are heated to fragmentation temperature before heat can dissipate into surrounding structures. Traditionally, for the treatment of skin pigments, relatively high fluences were used (5-7 J/cm^2). However, studies done in animal models suggest that the destructive threshold for tattoo pigments are around 0.9 J/cm^2 [4]. It is reasonable to believe that the destruction thresholds for other pigments are

similar to those of tattoo pigments. The threshold for the photoacoustic destruction of skin by Q-Switched Nd:YAG laser light is between 1.6-5 J/cm^2. This means that pigment destruction can take place without the ablation of skin; so this modality is both, selective, targeting pigmented structures, and non-ablative, being below the photo-acoustic threshold. This line of reasoning has led directly to the theory that the improvement of melasma by sub-thermolytic Q-switched Nd:YAG light is due to the selectivity of this light on a sub-celluar level, as it breaks aparts pigments only and not cells, leading this modality to be dubbed "sub cellular, selective, thermolysis" (SSP) [5]. Polnikorn hypothesizes that the mechanism of action may also involve biostimulation [2]. Often, however, there is some degree of damage which accompanies sub-thermolytic q-switched treatment, however this damage is much less then that which corresponds to thermolytic treatments, such that there is essentially no recovery period from treatment.

Nd:YAG light can be frequency doubled, going from a wavelength of 1064 nm (infrared light) to 532 nm (green light). The green light treats pigmented lesions superficially, it does not penetrate as deeply as infrared light [4].

The effective fluence of an Nd:YAG laser beam drops as a function of spotsize irrespective of pulse duration. This effect becomes very pronounced at smaller spotsizes with effective fluence halving from 10 to 3 mm [4].

Compared with traditional, high-fluence, therapies for pigmented lesions sub-thermolytic Q-switched therapy is relatively side-effect free [1]. The side effects usually include erythema and slight edema. However, Fitzpatrick skin type V patients can develope mottled hyperpigmentation [3].

III. CLINICAL STUDIES

Wattankrai and co-workers treated 22 patients with dermal or mixed type melasma in a split-face trial in which they compared treatement with sub-thermolytic Q-switched Nd:YAG and topical 2% hydroquinone with 2% hydroquinone alone [3]. Each patient was treated with 3.0-3.8 J/cm^2 at 10 Hz for 5 sessions at one week intervals. There was excellent improvement in mean relative lightness (16 of 22 excellent, 4 of 22 good) and a statistically and clinically significant difference in the improvement rate at week 3 and at week 7 (92 vs 20). However, once laser treatment was discontinued all of the patients experienced some degree of rebound hyperpigmentation; although the degree of lightening on the laser treated side was still greater than or equal to the degree of lightening on the control side. The mild side effects which were observed (erythema, transient burning, and slight edema) disappeared within an hour of the treatment. Three patients in the study developed mottled hyperpigmentation, they were all of skin type 5 (13.6%). And of 22 patients 8 developed confetti type hypopigmentation. These hypopigmentations are cosmetically problematic in darker skin types.

The self assessment of the patients was very positive, on the laser side of the face 7 patients were satisfied with treatment, 15 were very satisfied. This study shows that despite side effects patients find this therapy to be useful.

Polnikorn found that the delivery of sub-thermolytic (3.4 J/cm^2, 6 mm spotsize, 10 passes in one direction, 10 passes in the other) fluences to melasma lesions over 8 treatments (given weekly) was found to be effective when combined with a topical bleaching agent [2]. Follow up was conducted over a one year period. The end point of treatment was immediate pigment lightening, the whitening of fine hair, and perilesional erythema. Polnikorn presented 2 cases of refractory melasma in which clearing was successfully achieved with a combination of the above parameters and a topical 7% alpha arbutin solution. Based on his experience mottled hypopigmentation can appear gradually during treatment. Once any sign of it appears treatment should be stopped immediately, thereupon it will usually disappear.

Jeong found that using a Q-Switched laser weekly for 8 weeks with a 7-mm spotsize at a fluence of 1.6 to 2.0 J/cm^2 and two passes per treatment session was safe and effective [1]. In this study Jeong used triple combination cream (4% hydroquinone, 0.05% Tretinoin, 0.01% fluccinone acetonide) was used together with sub-thermolytic laser treatment. This treatment was performed on 13 patients of Fitzpatrick phototype III and IV as part of a split face study in which the laser therapy was evaluated against the triple combination cream alone. The authors found that both approaches were effective, but that laser therapy in combination with TC was superior.

IV. CONCLUSION

Melasma can be safely and successfully treated with sub-thermolytic Q-switched laser therapy. The results of various studies indicate that even very low fluences (1.6 J/cm^2) can be effective. In order to obtain the best results laser therapy should be combined with a topical hydroquinone based therapy. Initial research has shown that most common side effects are transient and mild, consisting of symptoms such as transient erythema and edema which disappear within an hour.

In dark Fitzpatrick phototypes (IV,V) fluences around 3.0 J/cm^2 often cause hypopigmentation, an alternative way may be to treat with very low fluences (around 1.6 J/cm^2). Based on theoretical considerations it should be possible to treat melasma with extremely low fluences (1 J/cm^2) although this has not been tried in practice. Hypopigmentation may occur slowly; there is consensus that upon seeing the first signs of hypopigmentation treatment should be discontinued.

After the cessation of laser therapy it is common for the melasma to rebound, however it usually stabalizes at a lighter level then it was initially.

Patients are overwhelmingly satisfied with laser based melasma treatments based on self assessments. The latest variable reflectivity unstable resonator Q-switched Nd:YAG lasers, combined with the vacuum cell Optoflex® technology delivery arm are capable of delivering high single pulse energies, with homogeneous top hat beam profiles at the treatment site [4]. Sub-thermolytic Q-switched laser therapy can be a safe and effective therapy for melasma if correctly applied.

REFERENCES

1. Jeong S, Shin J, Yeo U, Kim W, Kim I. Low-fluence Q-switched neodymium-doped yttrium aluminum garnet laser for melasma with pre- or post-treatment triple combination cream. Dermatol Surg., 2010; 36(6):909-18.
2. Polnikorn N. Treatment of refractory dermal melasma with the MedLite C6 Q-switched Nd:YAG laser: Two case reports. J Cosmet Laser Ther, 2008; 10(3):167-73.
3. Wattanakrai P, Mornchan R, Eimpunth S. Low-Fluence Q-Switched Neodymium-Doped Yttrium Aluminum Garnet (1,064 nm) Laser for the Treatment of Facial Melasma in Asians. Dermatol Surg., 2010; 36(1):76-87.
4. Cencic B, Lukac M, Marincek M, Vizintin Z. High Fluence, High Beam Quality Nd:YAG Laser with Optoflex Delivery System for Treating Benign Pigmented Lesions and Tatoos, J. Laser Health Academy, 2010; 1:9-18, www:laserandhealth.com.
5. Chan NPY, Ho SGY, Shek SYN, Yeung CK, Chan HH. A case series of facial depigmentation associated with low fluence Q-switched 1,064 nm Nd:YAG laser for skin rejuvenation and melasma. Lasers Surg Med., 2010; 42(8):712-9.