



ORIGINAL RESEARCH PAPER

Dermatology

"STUDY ON EFFICACY OF Q-SWITCHED ND: YAG LASER IN TREATING FACIAL HYPERPIGMENTARY DISORDERS"

KEY WORDS: Q switched Nd: YAG laser, Tattoo removal and Nevus of Ota.

Col (Dr) Mahendra Singh Deora

Associate Professor, Department of Dermatology Armed Forces Medical College, Pune-411040(Maharashtra)

Dr Gyaltzen Choden*

Senior Resident, Department of Dermatology Armed Forces Medical College, Pune-411040 (Maharashtra). *Corresponding Author

ABSTRACT

Hyperpigmentation is the darkening of an area of skin caused by increased melanin. Hyperpigmentary problems of the face are an important cosmetic problem. The common causes of hyperpigmentation of face are melasma, postinflammatory hyperpigmentation, solar lentiginos, freckles and nevus of Ota. Our aim was to study efficacy of Q-Switched Nd:YAG laser in treating facial hyperpigmentary disorders. Our study showed best result in treatment of tattoo forehead with 45.5% achievers and 45.5% responders followed by Nevus of Ota with 20% achievers and 50 % responders. The least effect was seen in Melasma with 33.3% responders and 66.7% failures.

Introduction:

Hyperpigmentation is the darkening of an area of skin caused by increased melanin. Hyperpigmentary problems of the face are an important cosmetic problem. The common causes of hyperpigmentation of face are melasma, postinflammatory hyperpigmentation, solar lentiginos, freckles and nevus of Ota. Pigmented lesions are classified as epidermal, dermal or mixed. It is important to know if the lesion is epidermal or dermal in origin in order to decide the mode of therapy.

Treatment of facial hyperpigmentation has always been challenging. Several treatment modalities are available like topical medications (eg - hydroquinone, tretinoin, azelaic acid, etc) and chemical peels (eg - glycolic acid, lactic acid, salicylic acid, trichloroacetic acid, Jessner's solution, kojic acid, alone or in various combinations). Laser therapy has added a new dimension especially in resistant cases. Since its theoretical beginning in Einstein's imagination, lasers have been used in treatment of conditions ranging from acne and hyperpigmentary disorders to photoaging and skin malignancy.

In 1966, Theodore Maiman, the creator of first ruby crystal laser, reflected on the possibilities for this new and exciting technology. Since then, lasers have become integral to the modern practice of medicine in the fields of Dermatology, plastic surgery, otolaryngology and phlebology. Treatment of pigmentary problems by Laser is based on the theory of selective photothermolysis which states that "selective heating is achieved by preferential laser light absorption and heat production in the target chromophore when the pulse duration is shorter than the thermal relaxation time of the target". This results in less collateral damage to surrounding tissues. The most common lasers used for treating pigmentary disorders are the Q-switched Nd:YAG laser (QSN, 1064nm and 532nm), the Q-switched ruby laser (QSR 694nm)& the Q-switched alexandrite laser (QSA 755nm). The Nd:YAG laser at 1064nm has following tissue effects. It ruptures melanosomes in laboratory animals causing epidermal depigmentation followed by gradual repigmentation and permanent leucotrichia, a suppresses collagen production in vitro and in vivo, and it has been extensively used in different fields like urology, ophthalmology, neurosurgery, dentistry, obstetrics/ gynaecology, gastroenterology, plastic surgery and dermatology for a wide range of applications.†

The Nd:YAG laser was first used by Goldman in studies on tattoos shortly after its invention in 1961. Laser operation of Nd:YAG was first demonstrated by J.E Geusic et al at Bell Laboratories in 1964.⁴ Though it was used primarily in endoscopic gastrointestinal laser surgery, particularly for bleeding, Landthaler et al.⁵ in Germany in the mid-1980s first advanced its use for therapy of large vascular cutaneous tumour. In 1990s Q- switched Nd:YAG laser became widely employed worldwide for treatment of tattoos and pigmented lesions.

Material and Methods

We conducted study to determine the efficacy of Q-switched Nd:YAG laser in treating facial hyperpigmentary disorders. Our descriptive study included total of 39 cases (11 for tattoo removal, 10 for nevus of Ota, 4 for post inflammatory hyperpigmentation, 4 for lentiginos, 4 for congenital melanocytic nevus and 6 for melasma) during the period from January 2012 to June 2013. They were recruited from the patients attending the Dermatology outpatient department of a tertiary teaching hospital. All patients were provided information, verbal and written about the study before enrolling them for same.

PATIENT INCLUSION CRITERIA

1. Both males & females were included in the study
2. Cases with facial hyperpigmentary disorders eg. Nevus of ota, lentiginos, melasma, CMN
3. Cases seeking removal of facial tattoos

PATIENT EXCLUSION CRITERIA

1. Pregnant and lactating patients
2. Cases with thyroid disorders
3. Cases with bleeding tendency
4. Cases with keloidal tendency
5. Cases with diabetes mellitus & hypertension
6. Cases on retinoids & steroids
7. Cases with herpes simplex virus infection

DATA COLLECTION

Thirty nine patients seeking treatment for various facial hyperpigmentary disorders in the form of nevus of Ota, melasma, postinflammatory hyperpigmentation, lentiginos, tattoos and congenital melanocytic nevus, were enrolled into the study after they qualified the inclusion criteria. Written informed consent was taken from each patient to enter the study after explaining about the procedure regarding the benefits and likely side effects in the language they understood. The cases were thoroughly assessed with detailed history of the condition including the treatment taken in the past for the same and clinical examination of the condition.

TREATMENT PROTOCOL

Neosys Q-switched Nd:YAG laser (1064nm and 532nm) was used for the study. A test patch was done on all the cases prior to starting the therapy. All cases were advised strict sun protection throughout the laser treatment schedule. Cases were reviewed two weeks after each sitting to look for any side effects.

Results and Discussion:

A total of 39 cases were included in the study with the following facial lesions comprising of 11 cases of tattoo, 10 cases of nevus of Ota, 4 cases of post-inflammatory hyperpigmentation, 4 cases of lentiginos, 4 cases of congenital melanocytic nevus and 6 cases of melasma.

TATTOO REMOVAL

Out of 11 cases of amateur forehead tattoo there were 5 (45.5%) achievers, 5 (45.5%) responders and 1 (9.1%) failure.

Among the above cases 7 had blue black tattoo and 4 had blue green tattoo. Blue black group had 5 achievers and 2 responders whereas blue green group had 3 responders, 1 failure and no achiever. This difference in response can be attributable to the small size of black pigment granules (0.5 μm to 4 μm) and their ability to absorb every wavelength of light which makes them easier to be removed whereas green pigment granules are about double the size of black pigment granules.

Jones et al.⁶ did a study using the Q-switched Nd: YAG laser to remove tattoos from type VI skin. Eight patients had 15 amateur tattoos treated with the Q-switched Nd: YAG laser, three or four sessions on an average at 8 weeks intervals. 8 of 15 tattoos were rated as 75-95 % cleared after therapy, five tattoos were 50% cleared and 2 tattoos were only 25% cleared. None of the patients reported any change in texture of their skin post therapy. No significant side effect was noted. They concluded that to treat patients in whom there is a significant risk for keloid scarring or destruction of natural pigment as a consequence of tattoo removal, the Q-switched Nd: YAG laser appears to be an excellent mode of therapy.

Furgeson et al.⁷ did a study on 231 amateur tattoos and 27 professional tattoos were treated with Nd: YAG laser (lambda 1064 nm and 532 nm). 79% of amateur black tattoos were $\geq 75\%$ clear after one to five treatments (mean 2) at 1064 nm. The response of professional tattoos was slower and less complete. Red tattoos responded well to 532 nm and were $\geq 75\%$ clear after 1 to 5 treatments. Yellow, orange, blue and green tattoos were resistant to treatment. Side effects included minor scarring in 1.2% of tattoos and transient pigmentary changes in 77% patients.

NEVUS OF OTA

Our study included ten cases of nevus of ota including three males and seven females. Three of them were of Fitzpatrick skin type V and rest were of type IV. They were treated using 1064nm Q switched Nd:YAG laser with fluence range of 4 – 7.5J/cm² and spot size of 3 - 4 mm. They received multiple sessions (average 5 sessions) at 8 weeks interval. The result showed 5 (50%) responders, 2 (20%) achievers and 3 (30%) failures. None of the patients had any side effects like post-inflammatory pigmentary changes or textural changes.

Kar HK et al.⁸ did a study to determine the efficacy and side effect profiles of Q switched Nd:YAG laser in fifty Indian patients of nevus of Ota who underwent multiple treatments (average 5 sessions) at monthly intervals carried out over a period of 2 years . The results showed near total improvement in 8%, marked improvement in 22%, moderate improvement in 38% and 32% patients reported less than 25% clearing of the lesion. All patients reported some improvement. Transient post inflammatory hyperpigmentation was observed in 4 (8%) patients, which cleared with use of sunscreen and bleaching agents within 2 months. No textural change or scarring was observed in any patient. They concluded that QSNYL is an easy to perform and effective treatment in cases of nevus of Ota in Indian patients with few side effects.

Another Indian study was done by Aurangabadkar S⁹ to evaluate long term safety and efficacy of Q-Switched Nd:YAG in 50 patients of nevus of Ota. They underwent multiple treatments (average 6 sessions) carried out over a period of one year with a Q-Switched Nd:YAG laser. Excellent improvement was noted in a majority of the patients at the end of the treatments. Greater than 60% improvement was seen in 66% of the patients. The remaining patients had moderate clearing of pigmentation (30%-60% improvement). No significant adverse effects were seen. They concluded that their study validates the superior efficacy of Q-Switched Nd: YAG laser when compared to conventional methods of treatment of nevus of Ota.

A study by Kak R et al¹⁰ done using Q-Switched ND: YAG laser to treat nevus of Ota showed similar findings.

CONGENITAL MELANOCYTIC NEVUS

Four cases of congenital melanocytic nevus were included in our study among which three were female and one male, one had Fitzpatrick skin type V and three of skin type IV. All of them were treated with Q switched Nd:YAG laser 1064nm with fluence range of 3 to 8J/cm², spot size of 3 to 4mm & frequency of 5 and 10 Hz .

They received multiple sessions (average of 5 sessions) at 8 weeks interval. The result showed responders 2 (50%) and failures 2 (50%). One of the failure case discontinued the treatment after 2nd sitting since there was not even a slight change in the lesion with 2 sessions. However none of the patients had any side effect following the laser therapy.

P.J. August et al¹¹ did a study on efficacy of CO2 laser and pigment-specific lasers in treating medium-sized Congenital Melanocytic Naevi. The study included 55 CMN cases out of which 36 were macular. From macular CMN, 17 cases were treated with Nd:YAG laser alone, 7 cases with Qs Alexandrite laser alone and rest with combination of CO2 laser and pigment-specific lasers. After mean treatment of 5 sittings, the cases treated with pigment-specific laser only showed less than 50% clearance in 2 cases, 50 – 75% clearance in 7 cases, and more than 75% clearance in 13 cases. Repigmentation occurred in 2 cases. They concluded that pretreatment of CMN with CO2 laser appears no more effective than pigment-specific laser alone in the treatment of macular CMN. Despite multiple treatment and initial clearance, there is a high risk of repigmentation with laser treatment of CMN.

Dave R et al did a study on combined early treatment of congenital melanocytic naevus with carbon dioxide and Nd:YAG lasers. Three cases of extensive congenital melanocytic naevi were treated with a combined approach using a ultrapulse carbon dioxide laser and a Nd Yag laser within 1 year of birth. The naevi were substantially depigmented and this result has been maintained for upto 36 months following treatment.

FRECKLES AND LENTIGENES

Four cases of lentigenes were included in our study comprising of three females and one male, all of them had Fitzpatrick skin type IV. All of them received multiple sessions (average 5 sittings) of Q-switched Nd:YAG laser with the following settings: Wavelength 532nm, fluence range 0.5 to 1J/cm², spot size of 3mm and frequency of 2 Hz. At the end of the study result showed that all 4 (100%) cases were responders. One case who received 6 sittings showed improvement with hypopigmentation over the treated lesions.

Rashid T et al¹² did a study to assess the efficacy and safety of Nd:YAG (532nm) laser in the treatment of freckles and lentigenes in type IV skin. In the study twenty adult patients (14 with freckles and 6 with lentigenes) were subjected to a variable number of treatments with a minimum 4-week interval until no additional improvement occurred or >75% improvement was obvious. Sixteen (80%) of 20 patients (freckles, n=10; lentigenes, n=6) manifested more than 50% improvement. Complications included hypopigmentation (25%), mild textural changes (15%) and hyperpigmentation (10%). All these were mild and resolved within 2-6 months. None of the patients with lentigenes showed recurrence. They concluded that frequency-doubled Nd:YAG (532nm) laser safely and effectively treats freckles and lentigenes in Fitzpatrick skin type IV.

MELASMA

Six cases of melasma (1 male and 5 females) were included in our study. All of them had Fitzpatrick skin type IV. They were treated with multiple sittings of Q-switched Nd:YAG laser (average 2 sittings) with the setting of wave length 1054nm, fluence range 1.1 to 2.5 J/cm², spot size range of 3 to 7 mm and frequency of 2 and 5 Hz. At the end of the study we had responders 2 (33.3%) who had received 3 to 4 sittings of laser therapy and failures 4(66.7%). Among the failures three had darkening of lesion after the first sitting and the therapy was discontinued. The darkening gradually faded over few months. There were no other significant side effects following the therapy.

Wattankrai and co-workers treated 22 patients with dermal or mixed type melasma in a split-face trial in which they compared treatment with sub-thermolytic Q-switched Nd:YAG and topical 2% hydroquinone with topical 2% hydroquinone alone.¹³ Each patient was treated with 3.0-3.8J/cm, 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. 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 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. Out of 22 patients 8 developed confetti type hypopigmentation.

Charu Bansal¹⁴ did a study on comparison of low fluence 1064 nm Q switched Nd:YAG laser with topical 20% Azeliac acid cream and their combination in Melasma in Indian patients. Sixty Indian patients with melasma were included and randomly divided into 3 groups. Group A-20 patients were treated with low fluence QSNYL, group B-20 patients were treated with 20% azeliac acid cream and group C-20 patients with combination of both. The improvement in the MASI score after 12 weeks therapy was maximum in group C followed by group A and group B. Hence concluded that a combination of low fluence QSNYL with azeliac acid is a promising option for the treatment of melasma.

POST INFLAMMATORY HYPERPIGMENTATION

Total of four cases of post-inflammatory hyperpigmentation were included in our study. Three of them had Fitzpatrick skin type IV and one was with skin type V. All of them were treated with multiple sittings of Q-switched Nd:YAG laser (average 4 sittings) with the following settings: Wave length 1064nm or 532nm depending on the depth of the lesion, fluence ranging from 1.1 to 5 J/cm, spot size 3 to 4mm and frequency of 2 or 5 Hz. The results showed 1 (25%) achiever 2 (50%) responders and 1 (25%) failure. The failure case discontinued therapy after two sittings since there was not even a slight change in the lesion after two sittings. However we did not encounter any significant side effect in any of the cases.

SB Cho et al¹⁵ reported three cases of post-inflammatory hyperpigmentation treated using 1064nm Q-Switched Nd:YAG laser with low fluence. First case, a 58 years old man with post-inflammatory hyperpigmentation over face was managed with 5 sessions of 1064nm Q-switched Nd:YAG laser at weekly interval with fluence of 1.9 – 2.6 J/cm, 6mm spot size and 3 passes with appropriate overlapping over the entire face followed by two passes of similar setting over the PIH area. The lesions didn't recur even after 2 months following treatment. The second case, a 39 years old lady with PIH over face was treated with five sessions of 1064nm Q-switched Nd:YAG laser with the setting of 1.9J/cm, 6mm spot size at weekly interval with extra 2 passes of the same setting over the PIH area. Patient remained in the improved state even 2 months after the last session. The third case, a 31 years old lady, with PIH over face who was also managed similarly as the above. Two cases maintained improved state even two months after the last session.

CONCLUSION

We conducted this study with the aim to determine the efficacy of Q-switched Nd:YAG laser in treating facial hyperpigmentary disorders. We included 39 cases with different types of facial hyperpigmentary disorders including Nevus of Ota, lentigenes, Post-inflammatory hyperpigmentation, Tattoo, Congenital melanocytic neavus and Melasma. All of them were treated with multiple sessions of Q-switched Nd:YAG laser.

Our study showed best result in treatment of tattoo forehead with 45.5% achievers and 45.5% responders followed by Nevus of Ota with 20% achievers and 50% responders. The least effect was seen in Melasma with 33.3% responders and 66.7% failures.

We observed darkening of the lesion following therapy in cases of melasma due to which we had to discontinue therapy in some of the cases. This gradually improved after stopping therapy.

During treatment of lentigenes using Q-switched Nd:YAG at 532nm, a patient developed hypopigmentation over the treated area after 4 sittings. Following which we switched to 1064nm for the remaining sessions. These lesions regained normal pigmentation in next two months. Throughout the study we did not experience any significant side effect with any of the patients. The overall result of our study showed Achievers 20.5%, Responders 51.3% and Failures 28.2%. Hence we conclude that Q-switched Nd:YAG laser (1064nm, 532nm) is a safe and effective mode of therapy for treating facial hyperpigmentary disorders.

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