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Laser therapy of freckles and lentigines with quasi-continuous, frequency-doubled, Nd:YAG (532 nm) laser in Fitzpatrick skin type IV: a 24-month follow-up

T Rashid, I Hussain, M Haider & TS Haroon

Authors:

T Rashid, I Hussain, M Haider & TS Haroon

Department of Dermatology, King Edward Medical College/Mayo Hospital, Lahore, Pakistan

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BACKGROUND: Newly developed lasers produce excellent results with minimal complications compared with traditional treatments for freckles and lentigines.

OBJECTIVES: To assess the efficacy and safety of the frequency-doubled Nd:YAG (532 nm) laser in the treatment of freckles and lentigines in type IV skin.

PATIENTS AND METHODS: Twenty adult patients (14 with freckles and six with lentigines) were subjected to a variable number of treatments with a minimum 4-week interval until no additional improvement occurred or >75% improvement was obvious. Patients manifesting >50% improvement were followed up once every 3 months for 24 months. The rest were regarded as treatment failures and not followed up.

RESULTS: Sixteen (80%) of 20

patients (freckles, $n=10$; lentigines, $n=6$) manifested more than 50% improvement. They were irradiated between three and eight times with a 4–12-week interval. Complications included hypopigmentation (25%), mild textural changes (15%) and hyperpigmentation (10%). All these were mild and resolved within 2–6 months. Of 10 patients with freckles followed up for 24 months, four (40%) patients showed partial recurrence. However, all the patients maintained >50% improvement. None of the patients with lentigines showed recurrence.

CONCLUSION: The quasi-continuous, frequency-doubled Nd:YAG (532 nm) laser safely and effectively treats freckles and lentigines in Fitzpatrick skin type IV.

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Introduction

Freckles and lentigines are a common problem, which not only cause substantial cosmetic morbidity but also

create psychosocial concern. Traditional treatments include camouflage with make-up, bleaching with hydroquinone, cryotherapy, chemical peels, and electrical cautery. These are often ineffective and associated with complications including hyperpigmentation, hypopigmentation and scarring.¹

Owing to the broad absorption spectrum of melanin,

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which ranges from 351 nm to 1064 nm, several lasers can effectively treat cutaneous pigmented lesions with minimal complications.^{2,3} These include the pulsed dye (510 nm), copper vapour (511 nm), krypton (520–530 nm), frequency-doubled Nd:YAG (532 nm), Q-switched ruby (694 nm), Q-switched alexandrite (755 nm) and Q-switched Nd:YAG (1064 nm) lasers.^{3,4}

Quasi-continuous lasers carry an increased risk of hypo- and hyperpigmentation and textural changes compared with pulsed lasers, especially in darker skin types.⁵ To the best of our knowledge, there are no reports assessing the efficacy, safety and long-term maintenance of substantial improvement following quasi-continuous, frequency-doubled Nd:YAG 532 nm laser treatment for freckles and lentigines in darker skin. The present study — the first of its kind from Pakistan — was planned to evaluate the efficacy, safety and long-term maintenance of improvement with this laser in Fitzpatrick skin type IV patients with freckles and lentigines.

Patients and methods

Twenty adult patients (18 women, two men) with freckles ($n=14$) and lentigines ($n=6$) attending the outpatient clinic of the Department of Dermatology, Mayo Hospital, Lahore, Pakistan, were enrolled in this study. The diagnosis of freckles and lentigines was based on their clinical appearance as biopsy on the face was declined by the majority of patients. Pale-brown macules in areas over-exposed to sun, with a history of aggravation due to sun, were labelled

freckles. Darker lesions, involving sun-exposed as well as covered areas, without any history of sun-related aggravation, were considered lentigines.⁶ Histopathology carried out in three patients (two with freckles and one with lentigines) was consistent with the clinical diagnosis.

The mean age of patients was 23.5 years (range 18–40 years). Table 1 depicts the complete profile of the patients. All had Fitzpatrick skin type IV. None of the patients had any systemic abnormality. Only facial lesions were treated in all patients.

A quasi-continuous, frequency-doubled Nd:YAG laser (Emerald; Crystal Focus, France) was used in the study. Its specifications included: wavelength 532 nm, pulse duration 1.6 μ s, frequency 14 kHz, power 0.1–4.5 W, exposure time 0.01 s — continuous, and spot size 2 mm. Pulse energy was verified with a laser power/energy meter (DGX OPHIR, France) at frequent intervals.

Written informed consent was obtained from all patients. Detailed history was taken and clinical examination performed. Necessary investigations were carried out to rule out associated systemic abnormalities in patients with generalized lentigines. Photographs under standardized conditions were taken before and after completion of treatment and then at the 24-month follow-up.

During therapy all individuals in the treatment room used protective eye-wear. No two pulses were given over the same spot in any one treatment session. Neither local anaesthesia nor a robotized automatic scanner was used.

Postoperatively patients were instructed to apply topical antibiotic ointment until the crusts fell off, to avoid sunlight exposure and to apply sunscreen lotion regularly.

Patient no.	Age (years) /sex	Lesion/site	No. of treatments	Improvement grade	Hypo-pigmentation	Hyper-pigmentation	Textural changes	Recurrence (within 24 months)
1	18/F	Freckles/face	8	4	+	–	+	+ (grade 3)
2	18/F	Freckles/face	7	4	–	+	–	–
3	20/F	Freckles/face	5	4	–	–	–	+ (grade 3)
4	30/F	Freckles/face	4	1	–	–	–	Treatment failure
5	31/F	Freckles/face	6	3	+	–	+	–
6	22/F	Freckles/face	7	3	–	–	+	–
7	22/F	Freckles/face	8	4	–	–	–	–
8	18/F	Freckles/face	4	2	–	–	–	Treatment failure
9	22/F	Freckles/face	6	4	–	+	–	+ (grade 3)
10	19/M	Freckles/face	5	3	–	–	–	–
11	25/F	Freckles/face	3	0	–	–	–	Treatment failure
12	40/F	Freckles/face	5	2	–	–	–	Treatment failure
13	23/F	Freckles/face	6	4	–	–	–	+ (grade 3)
14	18/F	Freckles/face	4	3	–	–	–	–
15	20/F	Lentigines/face	5	4	+	–	–	–
16	32/F	Lentigines/face	4	4	–	–	–	–
17	18/F	Lentigines/face	6	3	–	–	–	–
18	30/M	Lentigines/face	5	4	+	–	–	–
19	25/F	Lentigines/face	5	4	–	–	–	–
20	20/F	Lentigines/face	4	4	–	–	–	–

– = nil; + = present.

Table 1
Profile of patients.

Patients were subjected to a variable number of treatments with a minimum of 4-week intervals until no additional improvement was obvious or grade 4 improvement occurred (see below). At each visit, treatment areas were assessed against pretreatment photographic slides by two investigators (TR and MH). Responses were graded on a 0–4 scale (0 = no improvement, 1 = 1–25%, 2 = 26–50%, 3 = 51–75% and 4 = 76–100% improvement). Grades 3 and 4 were considered as effective. Any side-effects, graded as mild, moderate and severe, were also noted at the same time. The patients manifesting >50% improvement were followed up once every 3 months for a period of 24 months to assess any recurrence.

Results

All patients tolerated the laser therapy very well. Immediate post-treatment effects included pricking and burning sensations, ash-grey discolouration, erythema and oedema. The intensity of the effects correlated with the laser energy. A burning sensation was experienced for 1–6 h postoperatively. Crusts formed on the second or third postoperative day and lasted for 7–10 days.

Figure 1 gives an overview of the results of the study. Of 20 patients, 16 (80%) (freckles, $n=10$; lentiginos, $n=6$) manifested >50% (grades 3 and 4) improvement (Figures 2 and 3). The patients were irradiated three to eight times with 4–12-week intervals with an energy fluence of 7.25 J/cm^2 . Side-effects included hypopigmentation (25%), mild textural changes (15%) and hyperpigmentation (10%). These were mild and resolved within 2–6 months. None of the patients showed persistent textural and pigmentary change.

Of 10 patients with freckles followed for 24 months, four (40%) cases showed partial recurrence; however, grade 3 improvement was retained. No patient with lentiginos manifested recurrence.

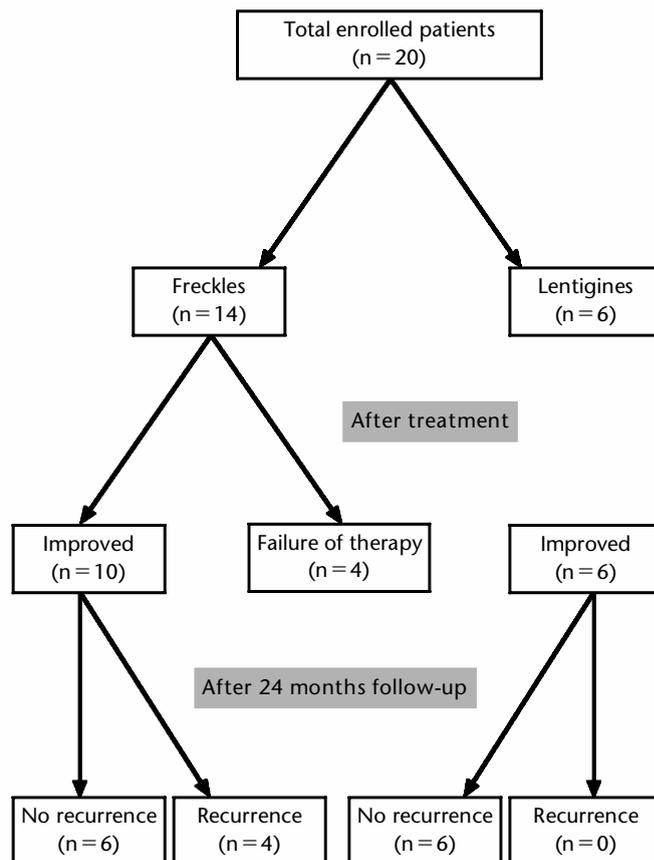


Figure 1
Study profile and overview of results.

Discussion

Many lasers have been used to treat epidermal pigmented lesions. Continuous wave lasers including the CO_2 and argon, though effective for the removal of pigmented lesions, cause non-specific damage leading to scarring, permanent textural changes and pigmentary alterations.⁷ Q-switched lasers including the ruby and frequency-doubled Nd:YAG (532 nm), designed on the principle of selective photothermolysis, treat epidermal pigmented lesions most specifically, with the lowest scarring poten-



(A)



(B)

Figure 2
(A) Freckles prior to treatment; (B) substantial clearing after 2-year follow-up.

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(A)

(B)

Figure 3

(A) Preoperative view of lentiginos over face; (B) marked improvement after 2-year follow-up.

tial.^{1,7,8} Todd et al⁹ reported the Q-switched, frequency-doubled, Nd:YAG laser to be better compared with the cryotherapy and krypton lasers. The pulsed pigmented lesion dye laser (PLDL), emitting green light at 510 nm, is considered ideal for the treatment of benign epidermal pigmented lesions as its penetration is limited to epidermis and absorption by melanin is much more than by haemoglobin.⁷ Quasi-continuous copper vapour (511 nm) and krypton (520–530 nm) lasers are effective in eliminating epidermal pigmented lesions; however, increased scarring potential has been mentioned.¹⁰ Data on the use of the quasi-continuous frequency-doubled Nd:YAG (532 nm) laser are lacking. As far as we know this is the first report evaluating the efficacy and safety of this laser for the treatment of freckles and lentiginos in type IV skin, including a 24-month follow-up.

At the conclusion of treatment, all the patients with lentiginos and 10 of 14 patients with freckles manifested more than 50% improvement after an average of 5.4 treatments. This improvement sustained in all the patients with lentiginos; however, partial recurrence (i.e. from grades 4 to 3) was observed in four of 10 (40%) patients with freckles. Better response in patients with lentiginos compared with freckles might be attributed to various factors. First, sunlight has an aggravating role in freckles but not in lentiginos; hence more chances of recurrence in freckles. Secondly, lentiginos, being darker in colour, contain a greater amount of chromophore; hence absorb more laser energy. These results show that like other quasi-continuous green light lasers such as the

copper vapour (511 nm) and krypton (520–530 nm),³ the quasi-continuous frequency-doubled Nd:YAG (532 nm) laser effectively treats epidermal pigmented lesions.

Complications noted were hypopigmentation (25%), mild textural changes (15%) and hyperpigmentation (10%). These were mild and resolved in 2–6 months. No case of persistent textural or pigmentary alterations was recorded. A similar side-effect profile has been noted with other lasers. Transient hypopigmentation has been reported in up to 25–50%, 50%, 47% and 29% of patients treated with Q-switched ruby, Q-switched alexandrite, quasi-continuous copper vapour and continuous wave CO₂ lasers, respectively.^{7,9} The reported incidence of transient cutaneous atrophy with Q-switched Nd:YAG, quasi-continuous copper vapour and Q-switched ruby lasers is 8%,¹¹ 20%⁷ and 50%,¹² respectively. The biggest risk of treating epidermal pigmented lesions in patients with darker skin types is postinflammatory hyperpigmentation. Pretreatment with bleaching agents is preferred in such individuals.⁵ A report mentioned hyperpigmentation in 10–15% of patients irradiated with the quasi-continuous copper vapour laser.¹³ PLDL therapy of benign epidermal pigmented lesions is associated with transient hyperpigmentation (15–33% of patients), and hypopigmentation and purpura (60% of cases).⁷ No case of purpura was observed in our study. We have shown that quasi-continuous Nd:YAG (532 nm) laser therapy of freckles and lentiginos in Asian (type IV) skin is not associated with an increased risk of scarring and permanent pigmentary changes.

It is concluded that the quasi-continuous frequency-doubled Nd:YAG (532 nm) laser safely and effectively treats freckles and lentigines in Asian type IV skin and significant improvement is maintained for at least 2 years. We suggest comparative studies evaluating the effi-

cacy, safety and long-term outcome of the quasi-continuous frequency-doubled Nd:YAG (532 nm) laser versus PLDL, quasi-continuous and Q-switched lasers in the treatment of freckles and lentigines.

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