REMOVAL OF TATTOOS AND PIGMENTS

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TATTOO AND PIGMENT REMOVAL

Neodymium-doped yttrium aluminium garnet (Nd:YAG) 1064-nm picosecond laser vs. Nd:YAG 1064-nm nanosecond laser in tattoo removal: a randomized controlled single-blind clinical trial.

Pinto F, Große-Büning S, Karsai S, Weiß C, Bäumler W, Hammes S, Felcht M, Raulin C. Br J Dermatol. 2017 Feb;176(2):457-464. doi: 10.1111/bjd.14962. Epub 2017 Jan 29.

BACKGROUND:
For decades, nanosecond lasers (NSLs) have been used to remove tattoos. Since 2012, pulses of picosecond lasers (PSLs) have been available for tattoo removal. Based on a few observational studies, the claim has been made that PSLs are considerably more effective while showing fewer side-effects in comparison with NSLs.

OBJECTIVES:
To compare the efficacy and side-effects of a PSL side by side with an NSL for tattoo removal.

METHODS:
Twenty-one patients with 30 black tattoos were treated with PSL and NSL in a split-study design in two sessions at intervals of 6 weeks. The safety and efficacy of laser treatments were determined by blinded observers assessing randomized digital photographs in this prospective clinical study. The primary end point was the clearance of the tattoos ranging in quartiles from 0% to 100%; secondary end points were side-effects and pain.

RESULTS:
The average clearance overall as evaluated showed no statistical difference between NSL and PSL (P = 1·00). Using a visual analogue scale (0 = no pain, 10 = maximum pain), a value of 3·8 ± 1·0 was reported for the PSL, which was statistically different from NSL (7·9 ± 1·1, P < 0·001). Transient side-effects were observed, as well as hypo- and hyperpigmentation, but there was no statistically significant difference between PSL and NSL.

CONCLUSIONS:
After two treatments of black tattoos with a neodymium-doped yttrium aluminium garnet laser (1064 nm), the use of picosecond pulses does not provide better clearance than nanosecond pulses. However, pain is less severe when using a PSL.

Picosecond 532 nm Neodymium-Doped Yttrium Aluminium Garnet Laser for the Treatment of Solar Lentigines in Darker Skin Types: Safety and Efficacy.

Guss L, Goldman MP, Wu DC. Dermatol Surg. 2017 Mar;43(3):456-459. doi: 10.1097/DSS. 0000000000000922.

Given the more focused thermal activity of picosecond lasers, we hypothesized that treatment of lentigos with a picosecond 532-nm neodymium-doped yttrium aluminium garnet (Nd:YAG) laser would be both efficacious and well tolerated in skin Type IV patients.

Dyspigmentation of the face including solar lentigos is of cosmetic concern to patients and may be difficult to treat in darker skin types such as Asians or Hispanics (skin Type III-IV) because of an increased adverse event profile including postinflammatory hyperpigmentation (PIH) and prolonged erythema.1

Picosecond lasers have been shown to be superior to Quality switched (Qs) nanosecond lasers in the removal of tattoo pigment.2 The shorter pulse duration in picosecond lasers obtains higher peak temperatures in tattoo particles or melanocytes with relative sparing of the surrounding dermal cellular elements and vasculature because of better heat confinement.2

PATIENTS AND METHODS

A retrospective chart review of all patients treated in our facility with a picosecond 532-nm Nd:YAG laser (Picoway, Syneron Candela, Wayland, MA) for benign solar lentigos on the face was obtained. Patients were excluded if their lesions had been treated in the past with any other laser, chemical peel, or liquid nitrogen. The Fitzpatrick skin type, lesion type, lesion number, and laser settings were recorded.

After obtaining informed consent and baseline photography, a single treatment session was performed using the picosecond 532-nm Nd:YAG laser by a single treating physician (D.C.W.). After treatment, all patients were instructed to apply sunblock and a bland emollient, use gentle skin care, and avoid scrubbing or picking at their skin. In addition, a 1-time topical application of triamcinolone acetate was performed immediately after treatment. Follow-up photographs were obtained 1 to 4 months later. Baseline and follow-up photographs were taken with the same lighting and background, using the same photographer and camera (Canon EOS Rebel T5i DSLR; Canon USA, NY). Lesions were individually counted, and the impact of treatment to each lesion was evaluated by a nontreating physician who was blinded to treatment settings and duration of follow-up (LG). Each lesion was categorized as worsened or improved using the following scale: 0% to 25%, 25% to 50%, 50% to 75%, or 75% to 100% improved. All adverse events, if any, were also recorded.

RESULTS

Two hundred fifty-five discrete pigmentary lesions from 6 patients (3 women and 3 men) were included in the study. Mean age was 31.3 6 12.6 years. All patients were of Hispanic or Asian ethnicity and had Fitzpatrick skin Type IV (Table 1).

TABLE 1. Patient Demographics

Sex	*Skin Type*	*Ethnicity*	*Age*
M	IV	Hispanic	19
M	IV	Chinese	32
F	IV	Chinese	20
F	IV	Hispanic	54
M	IV	Korean	33
F	IV	Vietnamese	30

A summary of the laser parameters used for treatment of the 6 individuals were: spot size 4.50 6 0.84 mm, fluence 0.65 6 0.16 J/cm^2, and pulse rate 1.67 6 1.63 Hz. Laser parameters used for each individual are summarized in Table 2.

TABLE 2. Treatment Parameters

Patient Treated	*Spot, mm*	*Fluence, J/cm^2*	*Pulse Rate, Hz*
Patient 1	4	0.5	1
Patient 2	4	0.8	1
Patient 3	6	0.5	1
Patient 4	4	0.8	1
Patient 5	4	0.8	1
Patient 6	5	0.5	5

Five of the 6 patients (83%) experienced more than 50% improvement in their lesions after only 1 treatment session. In total, 255 benign pigmented lesions were evaluated. Two hundred one of the 255 (78.82%) pigmented lesions were noted to have improved by 75% to 100% (Figure 1). Three of 255 (1.18%) had a 50%to 75% improvement; 17 of 255 (6.67%) had 25% to 50% improvement; and 32 of 255 (12.55%) had only minimal (0%–25%) improvement. Two lentigines (0.8%) worsened because of PIH, both in a patient who admitted to picking the treated area.

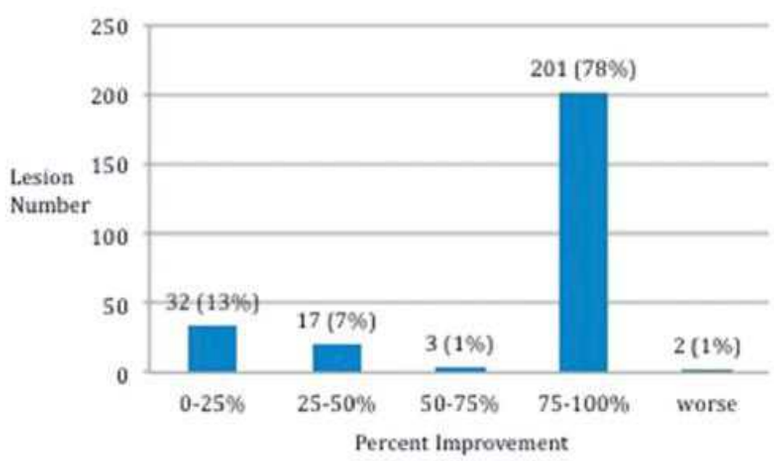


Figure 1. Percent improvement of benign pigmented lesions after 1 treatment session with the picosecond 532-nm neodymium-doped yttrium aluminium garnet laser. Two hundred fifty-five discrete lesions were evaluated. The vast majority (78%) improved by 75% to 100%.

No other cases of PIH were noted, and there were no cases of hypopigmentation. All patients were seen for follow-up photography between 1 and 4 months. One patient was seen in follow-up at 1 month, 1 patient at 2 months, 1 patient at 3 months, and 3 patients at 4 months. Representative clinical photography is shown in Figure 2. Treatments were well tolerated with minimal discomfort. Erythema and flaking to the treated sites resolved within a few days to a week. No additional treatments for lentigines were performed for these patients.

DISCUSSION

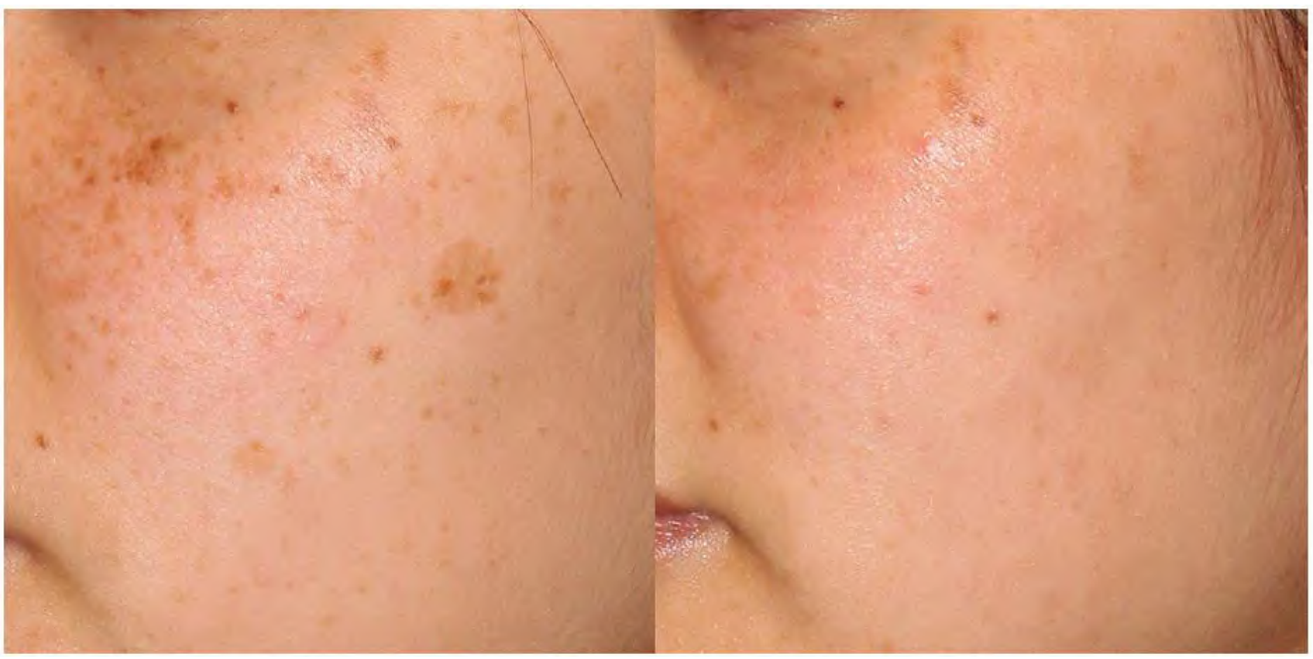
Qs nanosecond lasers are routinely used for treatment of pigmented lesions. However, the risk of PIH using Qs lasers in darker skin types is approximately 25%.1 This risk has been reported to increase to 47% when the treatment is specific for lentigines, possibly due to the melanocytic hyperplasia noted histologically in a lentigo.1 It has been hypothesized that PIH secondary to Qs lasers (which typically have a pulse duration between 2–80 ns) is due to an intense photothermal effect in the surrounding hemoglobin and melanin, which then leads to an inflammatory response.3 The picosecond laser used in this study has a pulse duration of 375 ps. The high-energy pulse is thought to induce ablation of its target through a photomechanical rather than or in addition to a photothermal effect, generating higher peak temperatures within the target and less nonspecific photothermal damage.3

In five of the six patients after only 1 treatment, the picosecond 532-nm laser worked extremely well, improving more than 78%of the lesions treated by at least 75%, and completely clearing many of them. Lesions which responded poorly were thicker lentigines, with a more seborrheic phenotype. The laser treatment was tolerated very well by all the patients.

Evidence of PIH was noted in only 2 of 255 total treated lesions, suggesting that the risk of PIH may be decreased in darker skin types through use of a picosecond laser. Both lesions were lentigines in the same patient who admitted to traumatizing the skin after his laser procedure. This underscores the critical importance of postprocedure care after laser treatment to optimize results. Our data supports the limited PIH noted in a previous study of a picosecond 755-nm alexandrite laser for benign pigmented lesions in Chinese skin, where fewer than 5% of patients experienced a transient hypopigmentation, and there were no incidents of hyperpigmentation. Of note, the 1 patient treated for a lentigo in that study noted only a 25% to 49% improvement.4 Though only 1 lesion was treated, this evidence may show that the 532-nm wavelength may be more efficacious than the 755-nm wavelength in treating lentigines. This difference is further supported by similar results noted in a comparison of Qs lasers used for treatment of lentigines. In Asian skin, a 755-nm Qs laser did not significantly reduce pigment in lentigines and had a higher risk of PIH when compared with a 532-nm Qs laser.5 Though both 532-nm and 755-nmwavelengths may be effective treatments for solar lentigines, the 2 potential advantages of a 532-nm wavelength are: greater absorption by melanin and shorter pulse duration leading to less nonspecific photothermal damage. This may explain the safety demonstrated in this report.

In summary, the picosecond 532-nm Nd:YAG laser seems to be safe and effective for treatment of solar lentigines after only 1 treatment session in darker skin types. Further clinical trials are required to determine the optimal treatment parameters and comparisons to existing laser and light modalities.

Figure 2. Complete clearance of numerous lentigines on the left cheek. Partial clearance (25%–50%) of several remaining lentigines on the infraorbital and medial cheek. No change was noted over the small junctional nevus on the infraorbital cheek.



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Clearance of yellow tattoo ink with a novel 532-nm picosecond laser.

Alabdulrazzaq H, Brauer JA, Bae YS, Geronemus RG. Lasers Surg Med. 2015 Apr;47(4):285-8. doi: 10.1002/lsm.22354.

BACKGROUND AND OBJECTIVES:
Although technology and tattoo removal methods continue to evolve, yellow pigment clearance continues to be challenging and usually unsuccessful. We describe a case series of six tattoos containing yellow ink, successfully treated with a frequency-doubled Nd:YAG 532-nm picosecond laser.

STUDY DESIGN/MATERIALS AND METHODS:
Case series with six subjects participating for the treatment of multicolored tattoos that contain yellow pigment. Treatments performed with a frequency-doubled Nd:YAG 532-nm picosecond laser at 6-8 week intervals.

RESULTS:
One subject achieved complete clearance of the treated site after one session, and five subjects required 2-4 treatments to achieve over 75% clearance. Minimal downtime was experienced, and no scarring or textural skin changes were observed in any of the treated sites.

CONCLUSIONS:
This is the first case series that demonstrates effective and consistent reduction of yellow tattoo ink using a frequency doubled Nd:YAG 532-nm laser with a picosecond pulse duration. Treatments were well tolerated and subjects had positive outcomes. This is a small observational case series from an ongoing clinical trial, and studies with a larger sample size and comparative group are needed in the future.

Comparison of responses of tattoos to picosecond and nanosecond Q-switched neodymium: YAG lasers.

Ross V, Naseef G, Lin G, Kelly M, Michaud N, Flotte TJ, Raythen J, Anderson RR. Arch Dermatol. 1998 Feb;134(2):167-71.

OBJECTIVE:
To test the hypothesis that picosecond laser pulses are more effective than nanosecond domain pulses in clearing of tattoos.

DESIGN:
Intratattoo comparison trial of 2 laser treatment modalities.

SETTING:
A large interdisciplinary biomedical laser laboratory on the campus of a tertiary medical center.

PATIENTS:
Consecutive patients with black tattoos were enrolled; all 16 patients completed the study.

INTERVENTION:
We treated designated parts of the same tattoo with 35-picosecond and 10-nanosecond pulses from 2 neodymium:YAG lasers. Patients received a total of 4 treatments at 4-week intervals. All laser pulse parameters were held constant except pulse duration. Radiation exposure was 0.65 J/cm2 at the skin surface. Biopsies were performed for routine microscopic and electron microscopic analysis at the initial treatment session and 4 weeks after the final treatment in 8 consenting patients. Also, ink samples were irradiated in vitro.

MAIN OUTCOME MEASURES:
In vivo, on the completion of treatment, a panel of dermatologists not associated with the study (and blinded to the treatment type) evaluated photographs to assess tattoo lightening. Formalin-fixed specimens were examined for qualitative epidermal and dermal changes as well as depth of pigment alteration. Electron micrographs were examined for particle electron density and size changes (in vivo and in vitro). The gross in vitro optical density changes were measured.

RESULTS:
In 12 of 16 tattoos, there was significant lightening in the picosecond-treated areas compared with those treated with nanosecond pulses. Mean depth of pigment alteration was greater for picosecond pulses, but the difference was not significant. In vivo biopsy specimens showed similar electron-lucent changes for both pulse durations. In vitro results were similar for both pulse durations, showing increases in particle sizes and decreased electron density as well as gross ink lightening.

CONCLUSIONS:
Picosecond pulses are more efficient than nanosecond pulses in clearing black tattoos. Black tattoos clear principally by laser-induced changes in the intrinsic optical properties of the ink.

Current concepts in aesthetic laser medicine: The 694-nm Q-switched ruby-laser

*Peter Arne Gerber[1], Said Hilton[2]
1. Department of Dermatology, Medical Faculty, University of Düsseldorf, Düsseldorf, Germany
2. Medical Skin Center, Dr. Hilton, Düsseldorf, Germany
Citation: EMJ Dermatol. 2014;2:56-60.

ABSTRACT

Quality-switched (q-switched) laser systems are the gold standard for the treatment of benign pigmented lesions and tattoo removal. A frequently used system is the q-switched ruby laser that emits monochromatic light at the wavelength of 694 nm. This system is used for the removal of age spots (senile lentigines), seborrhoeic keratosis, tattoos, and other dyschromatoses. The increasing need for the removal of, for example, age spots and unwanted tattoos, reflects both the wish of our ageing society to preserve a youthful appearance and the steadily growing prevalence of tattoos. This review highlights the potential, limitations, and novel treatment concepts of using q-switched ruby laser systems.

BIOPHYSICAL PRINCIPLES OF DERMATOLOGICAL LASER THERAPY

In 1983 R. Rox Anderson and John A. Parrish1 published their groundbreaking paper on the biophysical principle of laser therapy. Briefly, this principle of selective photothermolysis states that the efficacy of a medical laser relies on the specific absorption of radiation by distinct target chromophores. For lasers used in the dermatological practice, these chromophores are water (ablative lasers: the 2,940 nm Erb:YAG-laser or the 10,600 nm CO_2-laser), haemoglobin (treatment of vascular structures: the long-pulsed 532 nm and 1,064 nm Nd:YAG-laser or the 585 nm pulsed dye laser), and melanin (treatment of pigmented structures: quality-switched systems, such as the 694 nm ruby laser, the 532 nm and 1,064 nm Nd:YAG-laser, or the 755 nm alexandrite laser; laser epilation: long-pulsed systems, such as 1,064 nm Nd:YAG-lasers). Non-ablative laser systems emit radiation at wavelengths of approximately 500-1,200 nm, which allows the light deep enough into the skin to reach the target structures. This so-called optical window (~500–1,200 nm) is defined by the absorption of the epidermis/protein (<500 nm) and water (>1,200 nm).

The selective absorption of the monochromatic light emitted by the respective lasers, in the best case, enables us to generate a confined heating and hence, damage of the target chromophore, with no or minimal damage to the surrounding tissue. To achieve this optimal result, the pulse duration of our laser pulse should match the thermal relaxation time of the target. The thermal relaxation time is defined as the time that an object needs to dissipate 50% of the generated heat and depends on its diameter. Whereas larger structures (such as telangiectasia) are often treated with pulse durations of ≥30 ns, the small pigments require pulse durations of ≤80 ns, which can only be generated by quality-switched (q-switched) lasers. Ideally, these ultra-short, high-energy pulses (100–200 MW) do not only result in confined thermal damage but also generate a so-called photoacoustic effect that disrupts the pigment into micro-fragments and/or releases it from cellular structures. Subsequently, these fragments are discharged via the epidermis or transported to the draining lymph nodes by tissue macrophages. This process takes approximately 4-6 weeks.

Laser Therapy of Pigmented Structures

Q-switched laser systems, such as the 694 nm ruby-laser, the 532 nm and 1,064 nm Nd: YAG-laser, or the 755 nm alexandrite laser, are the gold standard for the treatment of benign pigmented lesions and tattoo removal. Indications for the q-switched ruby laser (QSRL) include, but are not restricted to, benign pigmented lesions (e.g. solar lentigo, ephelides, or certain nevi), tattoos (including dirt tattoos and permanent makeup), seborrhoeic keratosis, post-inflammatory hyperpigmentation, melasma, or drug-induced dyschromias. In this review, we will focus on the treatment of more common indications such as solar lentigo ('age spots') and tattoos.

The treatment of pigmented lesions using q-switched laser systems generates extreme energy and heat peaks that vaporise the water of the tissue surrounding the pigments. This vaporisation, and the photodisruption of the pigment, results in a 'snapping' noise and a whitish discolouration of the skin, i.e. the so-called blanching phenomenon (Figure 1). The blanching correlates with the generation of gas bubbles within the dermis and usually vanishes over a time period of 10-20 minutes.

LASER THERAPY OF TATTOOS

Tattoos have played an important role in various human cultures for thousands of years.2 An impressive example is the mummy of the iceman 'Ötzi', which dates back to >5,000 years, who displayed tattoos on his back and ankles. Today an estimated 25% of US citizens are tattooed and the prevalence is increasing. The word tattoo is derived from the Polynesian word 'Tatau', which means as much as pricking, hitting, or slitting. Accordingly, the process of tattooing includes the introduction of external pigment into the skin by respective techniques. Tattoos can be differentiated into five types: professional, amateur, cosmetic (permanent makeup), traumatic, and medical.3 The type of tattoo has an immediate influence on the efficacy of the laser tattoo-removal. Additional factors that influence the selection of the ideal type of laser and the efficacy of the treatment include colour, location, age, and skin-type of the patient. Whereas amateur tattoos often can be removed within 3-6 sessions, professional tattoos may require >20 sessions; the 694 nm ruby-laser may effectively remove black, dark blue, or green colours, while red colours can only be removed effectively with 532 nm Nd:YAL lasers. Multi-colour tattoos require the combination of different laser systems.

Potential complications of laser tattoo-removal include, but are not restricted to, hyper or hypopigmentation, scarring, changes in tattoo-colour, or reactivation of allergic reactions. Accordingly, the ideal time for the treatment of sun-exposed areas is the 'winter-season'. Tanned patients or patients that have planned a sunny vacation within the next 4-6 weeks should not be treated. The same accounts for patients that report allergic reactions following the tattoo-process.

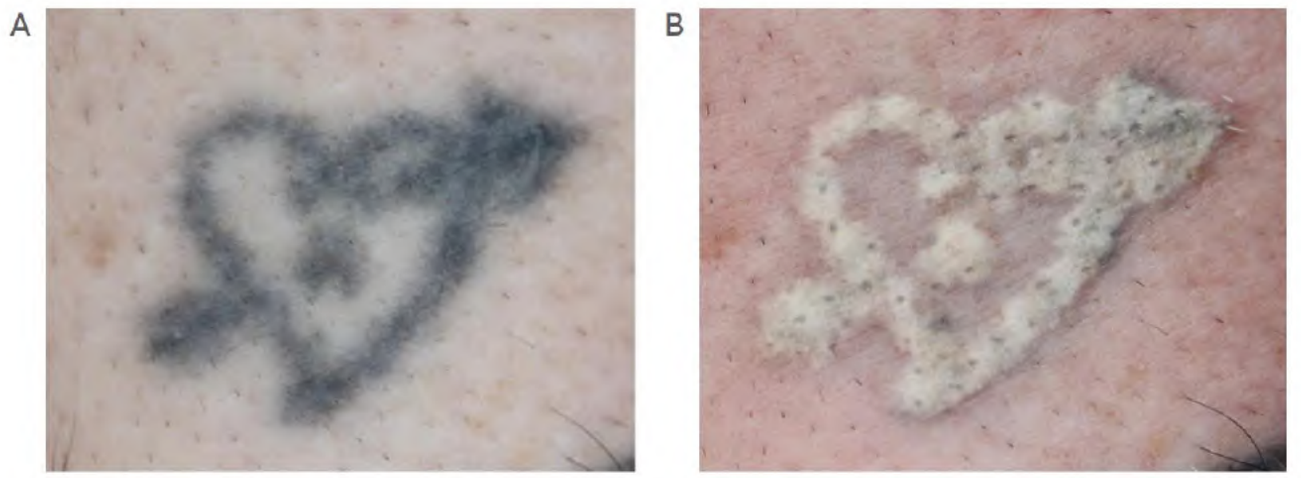

Figure 1: Blanching-phenomenon.
Heart-shaped tattoo on the forearm A prior to, and B immediately after treatment with a q-switched 649 nm ruby laser (TattooStar Effect, Asclepion Laser Technologies, Jena, Germany; spot: 4 mm Spot, fluence: 2.5 J/cm², passes: 1). The vaporisation of tissue-water results in a whitish discolouration (so-called 'blanching' or 'popcorn' phenomenon). The blanching vanishes over 10-20 minutes.

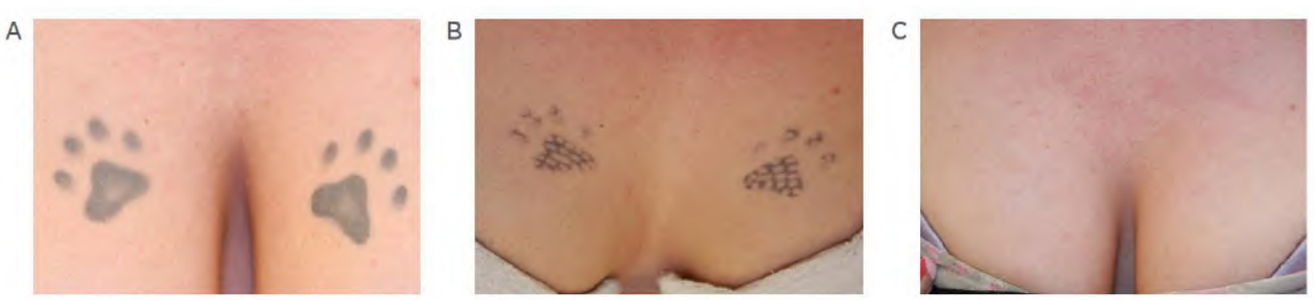

Figure 2: Treatment of a professional tattoo using the q-switched ruby laser.
Paw-shaped tattoos on the mammae A prior to, B after one session, and C after five sessions using a q-switched 649 nm ruby laser (TattooStar Effect, Asclepion Laser Technologies, Jena, Germany; spot: 4 mm Spot, fluence: 2.5 J/cm², passes: 1).

Treating physicians should be extremely cautious of pigmented nevi in the area of the tattoo. These nevi need to be covered or spared from any laser therapy. Notably, Pohl and co-workers4 have recently reported the first case of a malignant melanoma (MM) that developed on a pre-existing nevus within a tattoo during and between the phases of laser removal. Prior to the first laser treatment the nevus had been noticed within the tattoo but showed no alterations in thedermatoscopic analysis. As the patient refused the surgical removal of the nevus prior to laser therapy, laser therapy was initiated and the clinical course of the nevus was closely monitored under therapy. After a total of 47 sessions using different laser-systems (532 and 1,064 nm Nd:YAG and 755 nm alexandrite laser) the lesion was excised and a MM (Breslow's thickness of 0.45 mm) was diagnosed.

Prior to therapy, standardised photodocumentation is mandatory. Strict ultraviolet protection of the treated area is mandatory throughout the entire therapy and 6 weeks after. In our hands, the first session is restricted to a 'test-treatment' performed on a representative part of the tattoo and using

different treatment intensities. This test-treatment helps to determine the ideal therapy parameters (laser-system, fluence) and predict adverse reactions (e.g. scarring) as well as the estimated number of required sessions. It is prudent to perform such test spots, particularly when the ink composition is ambiguous. The blanching-phenomenon indicates that the selected treatment parameters are effective. If purpura is observed, the fluence should not be increased any further. Bleeding demands reduction of treatment intensity. The result of the test-treatment is evaluated and photodocumented after 2-4 weeks. The patient is questioned about any complications in the course (e.g. blisters, crusts, bleeding). Subsequently, laser-therapy is performed using effective but safe parameters. We strongly recommend starting the therapy using defensive parameters in order to avoid complications in the course. Therapy is performed using superficial analgesia with cooled air (e.g. Cryo 6 Derma, Zimmer MedizinSysteme, Neu-Ulm, Germany).

Whereas most patients tolerate the treatment solely with cooled air, topical anaesthetics can be applied prior to therapy in sensitive patients. In some patients pain can be severe and they will not tolerate just cold air and/or a topical anaesthetic; injectable anaesthetics may be required. However, any potent analgesia may increase the risk of adverse effects as the danger signal ‘pain’ may be turned off. Subsequently, an antiseptic ointment can be applied and cool-packs are used for at least 10 minutes. Topical sun screen (SPF 50+) is advised throughout the entire treatment period. Since the pulses should not overlap during the treatment to avoid bulk-heating and complications, the tattoo will show a ‘dotted’ appearance in the course of the therapy (Figure 2). Treatments are repeated every 4-6 weeks. An increase of the treatment intervals may result in a reduced number of overall treatments that are needed to completely remove the tattoo. This is due to the fact that the immune system has more time to ‘remove’ pigment fragments from the tattoo area (please also refer to Biophysical principles). Nevertheless, prolonged treatment-intervals are likely to increase the overall time needed to achieve a complete removal.

The use of the QSRL can achieve excellent cosmetic results (Figure 2); nevertheless, the patient must be educated prior to the therapy that the tattooing-process often results in a permanent alteration of the skin-structure. Hence, removing the colour from the tattooed area may ‘uncover’ a tattoo-shaped scar (Figure 3). If the patient is not educated about this fact, the individual may associate the scar with the process of an ‘incorrect’ laser-therapy. Furthermore, in approximately 40% of the cases, QSRL-therapy is associated with transient hypopigmentation (Figure 3).5 This may be permanent in approximately 10% of the cases.6 The occurrence of hypopigmentation correlates with the number of treatment-sessions. Another potential complication must be warranted when treating cosmetic tattoos. In fact, laser therapy of red permanent makeup, which is usually applied to accentuate the contour of lips, may result in an oxidation of the pigment and a subsequent black discolouration.6 Hence, when treating permanent makeup, a test-treatment is mandatory. In most cases, the first treatment will induce the discolouration to black, which is then effectively removed with the QSRL in the course. However, the patient must be educated about the stigmatising appearance until complete pigment removal is achieved.

As mentioned before, the removal of a tattoo often requires multiple treatment sessions, which is associated with a distinct timely and financial burden for the patient. Thus, there is an urgent need for novel techniques that may reduce the number of treatments needed. In this context, Anderson and Parrish1 recently published the so-called ‘R20’ method.7 The authors propose that the blanching that

is observed after the treatment of tattoos using q-switched laser systems (Figure 1) limits the number of effective passes to one, as the forming gas bubbles in the dermis scatter light and prevent the laser from reaching pigments located in the deeper dermis. However, the application of multiple passes after the blanching vanished (approximately 20 minutes, and therefore, 'R20'-technique) in one session resulted in a significant increase of the efficacy of each session. In our hands, this 'R20' technique has proven its benefit, and we were able to reduce the number of sessions by approximately 25% when we performed two passes per session. Whereas Anderson and Parrish1 reported that they used four passes per session in their study and observed an even better efficacy than we did, we advise to restrict the therapy to two passes per session in order to avoid complications. In fact, we suggest that the 'R20'-technique should only be performed by experienced laser physicians. We have made the observation that it is effective and 'risk-averse' to start the treatment with single passes and to switch to 'R20' once the density of the pigment is reduced in a further course of therapy.

Finally, the latest developments in laser tattoo removal are q-switched laser systems that emit extreme short pulses in the picosecond range and that have been proposed to effectively remove multi-coloured tattoos within one or two sessions.8,9

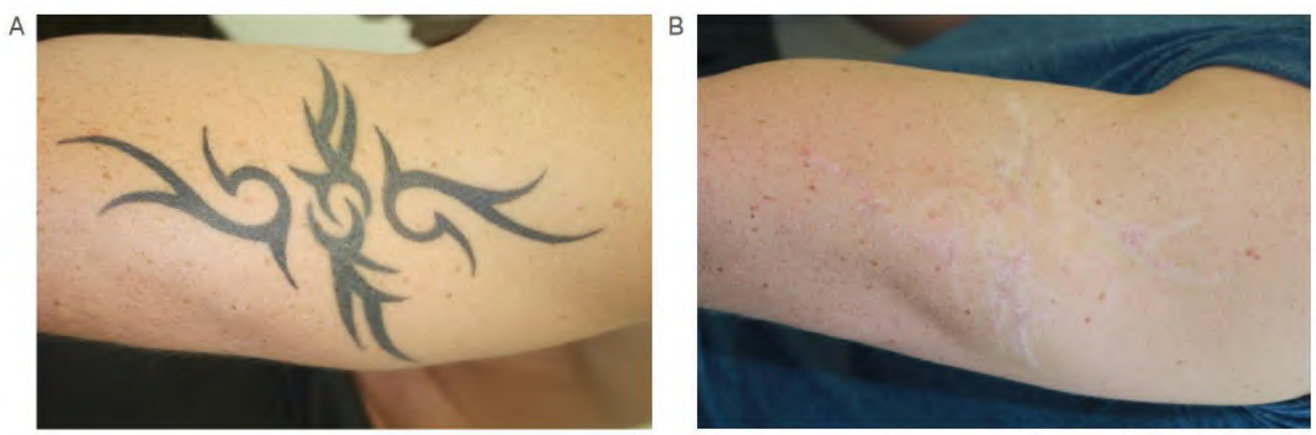

Figure 3: Treatment of a professional tattoo using the q-switched ruby laser.
Tribal-shaped tattoos on the forearm A prior to, and B after 15 session using a q-switched 649 nm ruby laser (TattooStar Effect, Asclepion Laser Technologies, Jena, Germany; spot: 4 mm Spot, fluence: 2.5 J/ cm^2, passes: 1). At the end of the therapy (B), a tattoo-shaped, hypopigmentation with an alteration of the skin-structure is visible.

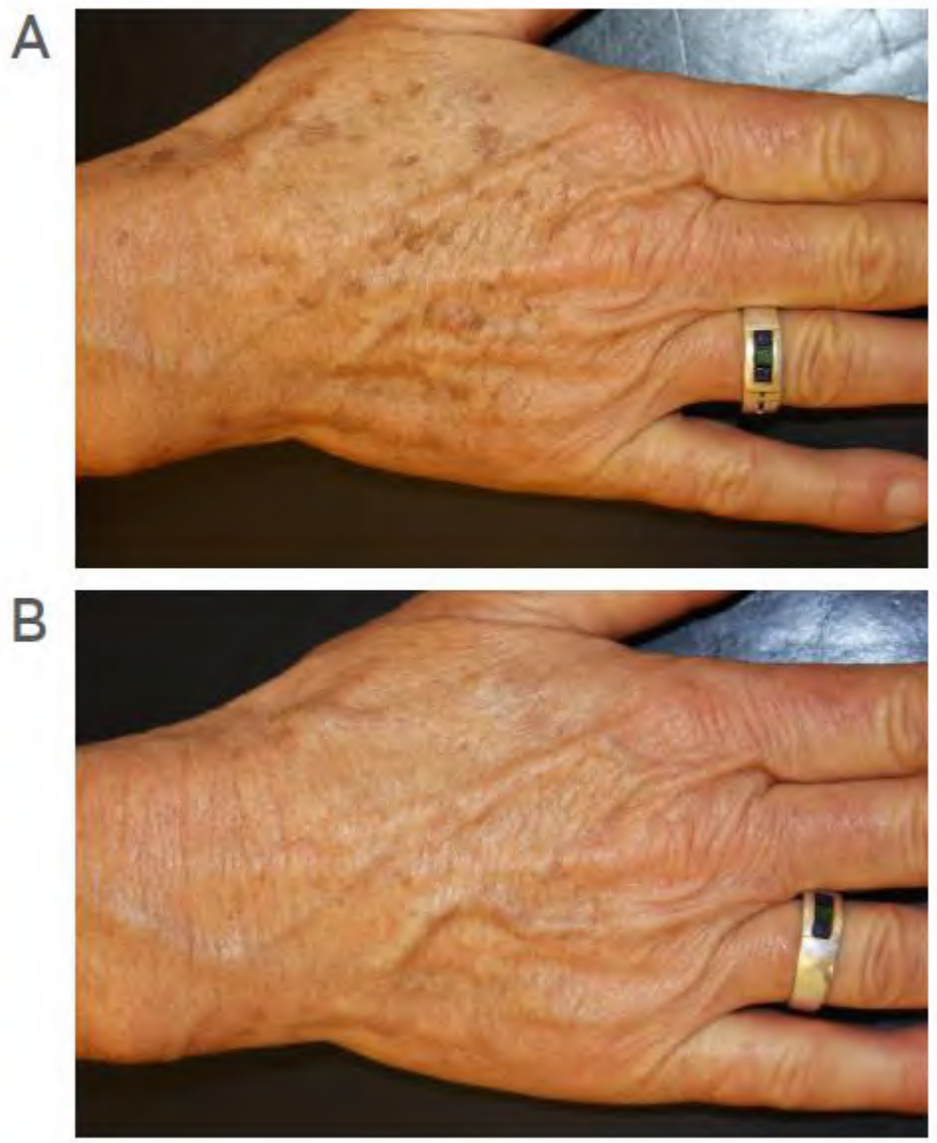

Figure 4: Treatment of solar lentigines ('age spots') using the q-switched ruby laser.
Lentigines on the hand A prior to, and B 3 weeks after a single treatment using a q-switched 649 nm ruby laser (TattooStar Effect, Asclepion Laser Technologies, Jena, Germany; spot: 4 mm Spot, fluence: 4.0 J/cm², passes: 1).

However, whereas we regard the picosecond technology as a very promising development, in our view, a close look at the images presented in the original publications show some scarring in the follow-ups, and further controlled studies with larger patient collectives are needed to prove the superiority of these systems.

LASER THERAPY OF BENIGN PIGMENT LESIONS

The QSRL is extremely effective in the treatment of benign pigment lesions. In the most cases solar lentigines ('age spots') or flat, pigmented seborrhoeic keratosis can be removed within a single session (Figure 4). Prior to therapy, the diagnosis and dignity of the treated lesions must be determined. As we have mentioned before, Pohl and co-workers4 have recently reported that the laser treatment of a pigmented nevus resulted in malignant transformation and the development of a MM. Diagnostic procedures include dermatoscopy and or the histopathological analysis of representative superficial (shave) biopsies. In particular when treating facial pigmented lesions, the differential diagnosis includes lentigo or even lentigo maligna melanoma. Therefore, we advise to perform histopathological analysis of shave biopsies prior to any laser-treatments of facial pigmented lesions, if possible, or at least if there are any signs of atypia. Facial pigmented lesions that reoccur after laser-therapy should undergo immediate histopathological evaluation.

In accordance with the treatment of tattoos, test-treatment should be performed when treating large lesions. Tanned patients should not be treated, and sun-exposed areas should not be treated in the 'summer season'. During this time of the year, patients can be advised to apply de-pigmenting ointments and sunscreen. Topical sunscreen (SPF 50+) is also mandatory for at least 6 weeks post-treatment.

SUMMARY

Today, q-switched laser systems are the gold standard for the removal of tattoos and the treatment of benign pigmented lesions. In our hands, the QSRL has proven itself as a reliable and effective system for the management of a broad variety of indications. Novel techniques and laser-systems grant interesting and novel treatment options for new and experienced users.

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Red ink tattoo reactions: successful treatment with the Q-switched 532 nm Nd:YAG laser.

Antony FC, Harland CC.: Br J Dermatol. 2003 Jul;149(1):94-8.

BACKGROUND:
In the South-west Thames region there were an unprecedented number of lichenoid tattoo reactions to red ink in patients who had visited a local tattoo parlour. The red ink was found to contain mercuric sulphide, a compound known to cause allergic reactions. Topical Dermovate (clobetasol propionate 0.05%, GlaxoWellcome) ointment alone had little impact.

OBJECTIVES:
To investigate whether the Q-switched 532 nm Nd:YAG laser could produce permanent flattening of the reaction.

METHODS:
This was an open nonrandomized clinical trial. Biopsies were taken from the lichenoid areas within the tattoos. Subjects were patch tested to 1% ammoniated mercury in petrolatum prior to treatment with the Q-switched 532 nm Nd:YAG laser. Laser treatments were delivered at 6-weekly intervals by a single operator. Patients also applied topical Dermovate between treatments. Therapy was discontinued when the lesions flattened. Clinical photographs were assessed at baseline and prior to each laser treatment.

RESULTS:
Seven patients with Fitzpatrick skin types I-III were enrolled in the study (four females, three males, mean age 39 years). All patients completed the trial. Patch testing to mercury was universally negative at 48 and 96 h. Substantial flattening and depigmentation of the red ink within the tattoos was noted after six laser treatments. No adverse effects were recorded.

CONCLUSIONS:
The Q-switched 532 nm Nd:YAG laser in combination with topical Dermovate ointment is a safe and effective method of treating red ink tattoo reactions.

Comparison of the Q-switched alexandrite, Nd:YAG, and ruby lasers in treating blue-black tattoos.

Leuenberger ML, Mulas MW, Hata TR, Goldman MP, Fitzpatrick RE, Grevelink JM. Dermatol Surg. 1999 Jan;25(1):10-4.

BACKGROUND:
A new generation of highly selective short-pulsed lasers has emerged in recent years for the treatment of tattoos. Several studies (including reports by the present investigators) have proven the efficacy of each of the three commercially available, FDA approved devices; namely, the Q-switched alexandrite, Q-switched Nd:YAG and Q-switched ruby lasers. Considerable differences among the three have been reported in relation to the rate of clearing of the tattoo ink particles, tissue effects, beam profile, wound healing, and side effects.

OBJECTIVE:
This study was primarily conducted to examine and compare the clinical response of patients with blue-black tattoos simultaneously treated with three different Q-switched lasers (alexandrite, Nd:YAG, ruby) with a focus on the percentage of tattoo lightening/clearance and the occurrence or non-occurrence of pigmentary change as a side effect.

METHODS:
A total of forty-two blue-black tattoos seen at two laser centers (Massachusetts General Hospital Dermatology Laser Center and Laser and Skin Surgery Center of La Jolla) were simultaneously treated with three types of Q-switched lasers: a Candela Q-switched alexandrite laser (755nm 50-100 nanoseconds, 3.0 mm spot size, 6-8 J/cm^2); a Continuum Biomedical Q-switched Nd:YAG laser (1064nm, 10-20 nanoseconds, 3.0 mm spot size, 5-10 J/cm^2); and a Spectrum Q-switched ruby laser (694 nm, 25-40 nanoseconds, 5.0 mm spot size, 4-10 J/cm^2). Paired t-tests and McNemar tests were used to compare the treatment outcome and pigmentation side effects between sites per tattoo, with each site representative of one of the three lasers. The statistical significance level was set at $p < .05$.

RESULTS:
Overall, the Q-switched ruby laser had a significant difference in tattoo lightening versus the Q-switched Nd:YAG and Q-switched alexandrite lasers. An increase in the number of treatments paralleled a statistically significant increase in tattoo clearance for all three Q-switched lasers.

CONCLUSION:
The Q-switched ruby laser had the highest clearance rate in blue-black tattoos and the highest incidence of long-lasting hypopigmentation. The Nd:YAG had no incidence of hypopigmentation.

Q-switched Ruby laser in the Treatment of Facial Epidermal Pigmented Dermatoses

Huang Yi, Huang Minghuan, Department of Dermatology, East Hospital, Shanghai, China

Objective: To observe clinical changes in patients with facial epidermal pigmented dermatoses treated with Q-switched Ruby laser. **Methods:** 164 cases with ephelides, café aulait macules, lentigines, seborrheic keratosis were treated by Q-switched Ruby laser. Treatment intervals were 3-6 months. **Results:** 122 cases were cured and 42 cases had marked effect after 1-2 times treatment. There was a marked therapeutic effect (74%) achieved. No scars appeared in all patients. **Conclusion:** Q-switched Ruby laser was secure and excellent in curing oriental facial epidermal pigmented dermatoses.

Superficial pigmented dermatoses occurring on the face usually brings about adverse cosmetic effects. Previous treatment methods such as cryotherapy, electric cautery, CO2 laser and radiofrequency have obvious side effects. We have treated 164 cases of ephelide, café au lait, lentigines and seborrheic keratosis since 2002, having obtained satisfactory cosmetic results after more than 1 year of clinical observation.

1. Material and Methods

1.1 Clinical data:

164 (male 52, female 112) patients all came from outpatient department of dermatology, aged between 6 and 68 (average 32.6). Among them, are 32 cases of ephelides, 36 cases of café au lait, 23 cases of lentigines and 73 cases seborrheic keratosis. The history of the lesions is ranged from 3 months to 50 years (average 11.5 years). 32 patients had 2 pigmentary disorders simultaneously, accounting for 19% of total cases, yet only the major disorder was evaluated.

1.2 Treatment:

Laser system: Q-switched Ruby laser (RubyStar$^+$, Asclepion Laser Technologies GmbH, Germany) at 694nm was used for treatment, with the aiming beam at 635nm. The pulse width was 30ns, spot size adjustable from 3.5mm to 5.0mm, fluence adjustable from 3.4 to 13.0 J/cm^2. The major parameters were listed in table1.

Procedure:

Table1 Major parameters used in treatment

disease	spot size [mm]	fluence [J/cm^2]	frequency
ephelide	3.5-5	3.4-7.3	single-continuous
café au lait	4-5	3.4-5.6	continuous
lentigines	3.5-4	5.6-10.4	single
seborrheic keratosis	4-5	3.4-6.8	single-continuous

The areas to be treated were routinely cleaned and sterilized before treatment and some were photographed. Operators and patients all wore goggles for eye protection.
Spot size and fluence were chosen according to skin tone, lesion size, degree of pigmentation, thickness and area to be treated and adjusted according to the immediate reaction during treatment. No anesthetics were used.
After the skin lesion was targeted with the aiming beam, footswitch was pressed and the lesion was irradiated by the emitted laser. Immediately after irradiation, there were grayish patches accompanied by slight pain at the irradiated area, afterwards edema and erythema appeared. There was also slight burning sensation that would disappear within 30 minutes. Ice pack was applied to large irradiated areas for 30 minutes to alleviate pain and burning sensation.
No medicine was administered after the operation, and the irradiated area was required to keep dry. Crust that was formed 1 day after operation would shed 7-14 days later. Regenerated epidermis was reddish in colour, and avoidance of sun exposure was required. Follow-ups were carried out 3 and 6 months after treatment for evaluation of clinical response.

1.3 Evaluation of clinical response:

Clinical response was evaluated by both doctors and patients. “Cure” means complete clearance of pigment, “excellent” clearance>70%, “effective” clearance>50%. Cases cured after 2 treatments were evaluated as effective.

2. Results

122 of 164 patients were cured after 1 treatment and 42 were cured after 2 treatments. Cure rate after 1 treatment was 74%. Effective rate was 100%. Hyperpigmentation was still obvious 3 months after operation in 26 cases, diminishing gradually 6 months later. The longest time for diminishing of hyperpigmentation was 8.5 months after operation in 1 case. There was no hypopigmentation and scar formation in 164 cases.

Procedure:

Table1 Major parameters used in treatment

disease	spot size [mm]	fluence [J/cm^2]	frequency
ephelide	3.5-5	3.4-7.3	single-continuous
café au lait	4-5	3.4-5.6	continuous
lentigines	3.5-4	5.6-10.4	single
seborrheic keratosis	4-5	3.4-6.8	single-continuous

3. Discussion

Superficial pigmentary dermatoses were selected for treatment, since pigmentation in these cases was distributed at the basal layer. Selectively destroyed by RubyStar at 694nm, melanocytes are vacuolated and fragmented. Cell debris is scavenged by macrophages and the pigmented lesion will disappear. It has been proved that dye laser, YAG laser and Ruby laser can be used for pigmentary skin disorder. The pulse width of these lasers is shorter than the thermal relaxation time (TRT) of melanosome, therefore most of epidermal cells are kept intact and regeneration of cells is made easy.
There is no controversy over the treatment of pigmentary skin disorder with RubyStar, but there is more melanin in the skin of oriental people. 2 questions will arise concerning the treatment of them. The first concerns the selection of cases. Which has better response, light lesion or dark lesion? The second concerns the effect of skin tone on clinical response. The major objective of our observation is to make clear whether hypo- or hyperpigmentation will occur in the area treated with RubyStar.
According to our observation, the number of treatment depends on the distribution of pigment in the skin lesion. The more superficial the lesion, the less number of treatment. Generally speaking, only 1 treatment is required for superficial pigmentary skin disorder. The clinical response of ephelide is the best, whereas hypertrophic seborrheic keratosis is not suitable for RubyStar therapy.
The skin tone is an influencing factor of fluence chosen and prognosis, since the amount of melanin in melanocytes is dependent upon skin tone. However safe the Q-switched laser is, even slight injury is likely to cause hyperpigmentation which is dependent on the reaction of melanocytes to injury. Those dark skinned should be informed of possible delayed clearance of pigmentation. Appropriate fluence should be selected in order to prevent complete damage of epidermis by too high fluence. Delayed recovery is likely to cause prolonged hyperpigmentation.
Removal of crust too early, ultraviolet exposure and history of melasma are also risk factors of prolonged hyperpigmentation. Complete pigment clearance will take 6-9 months in dark skinned patients according to our observation. The next session of treatment can be started if there is no further pigment fading for more than 3 months.
For patients with slight melasma, observation for 6 months is required, and the second treatment too early is not recommended. Such principle is also applicable to pigmentary dermatoses at other sites. In our treated cases, there is no hypopigmentation, depigmentation or scar formation.

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Entfernung von Tätowierungen mit dem gütegeschalteten Rubinlaser (694 nm) und dem gütegeschalteten Nd:YAG-Laser (532 und 1064 nm) Eine Retrospektivstudie

Saskia Werner, Michael Drosner, Christian Raulin: Der Hautarzt, March 1999, Volume 50, Issue 3, pp 174-180

Zusammenfassung

Im Rahmen einer Retrospektivstudie wurden 47 Patienten mit 68 Laien- und 25 Profitätowierungen hinsichtlich des Aufhellungsgrades und des Auftretens von Nebenwirkungen nach abgeschlossener Behandlung mit dem gütegeschalteten Rubinlaser (694 nm) bzw. dem gütegeschalteten Nd:YAG-Laser (532 und 1064 nm) untersucht. Es konnte gezeigt werden, daß schwarze Amateurtätowierungen schneller entfernt werden konnten als professionell gestochene Tattoos (13,2 vs. 18,6 Sitzungen bei Kombination von Rubin- und Nd:YAG-Laser). Mehrfarbige Tätowierungen benötigten bis zur kompletten Aufhellung vergleichbar häufige Laserbehandlungen. Grüne Farben wurden hierbei mit dem Rubinlaser, rote Pigmente mit dem frequenzverdoppelten Nd:YAG-Laser entfernt. Der gütegeschaltete Rubinlaser und gütegeschaltete frequenzverdoppelte Nd:YAG-Laser (532 nm) verursachten posttherapeutisch häufiger Blasenbildung (5,4% bzw. 7,5%) und transiente Hypopigmentierungen (8,6% bzw. 15,1%) als der gütegeschaltete Nd:YAG-Laser (1064 nm) (1,1 bzw. 4,3%).

Summary

In a retrospective study 47 patients with 68 amateur and 25 professional tattoos were examined, considering clearance of tattoo pigments and the frequency of side effects after finished treatments with the Q-switched ruby (694 nm) and the Q-switched Nd:YAG laser (532 and 1064 nm). Black amateur tattoos were found to lighten faster than professional tattoos (13,2 and 18,6 treatments respectively). For the clearance of multicolored tattoos (amateur or professional), similar numbers of laser treatments were needed. Green pigments were removed with the Q-switched ruby laser and red pigments with the frequency-doubled Nd:YAG laser (532 nm). Compared to the Q-switched Nd:YAG laser (1064 nm), the Q-switched ruby laser and the frequency-doubled Nd:YAG laser (532 nm) more often caused blistering and transient hypopigmentation (5,4% and 7,5% vs. 1,1% (blisters); 8.6% and 15.1% vs.4.3% (hypopigmentation).

Tattoo removal with the Q-switched ruby laser and the Q-switched Nd:YAG laser: a comparative study

Levine VJ, Geronemus RG.: 1995 May;55(5):291-6.

Abstract

The Q-switched ruby and the Q-switched neodymium YAG lasers are both widely used in the treatment of amateur and professional tattoos. Comparative evaluation of these two laser systems has not previously been performed; thus, the advantages of each laser have not been delineated. Forty-eight amateur and professional tattoos were treated with both the Q-switched ruby and Q-switched Nd:YAG lasers. The tattoos were divided in half and one side of the tattoo was treated with each laser. After one treatment, the patients returned for evaluation to assess the degree of lightening achieved by each laser. The Q-switched ruby laser was found to be superior in lightening black dye in both professional and amateur tattoos. A significant advantage was noted for the ruby laser in the removal of green tattoo pigment. The differences with the Q-switched ruby laser and the 1064 nm option of the Q-switched YAG laser were not clinically significant in the lightening or removal of other colors. The 532 nm option of the Q-switched YAG laser was superior to the Q-switched ruby and the 1064 nm option of the YAG laser in the removal of red tattoo colors in professional tattoos. Hypopigmentation was found more commonly with the Q-switched ruby laser, while textural change was noted more commonly with the Q-switched Nd:YAG laser. One of the patients treated with the Nd:YAG laser at 1064 nm showed a hypertrophic scar.

FRACTIONAL TREATMENT

The Efficacy of a Q-Switched 694-nm Ruby Fractional Laser for Treating Acquired Bilateral Nevus of Ota-Like Macules

Sun Jae Lee, Seung Min Nam, Han Gyu Cha, Eun Soo Park, Yong Bae Kim
Department of Plastic and Reconstructive Surgery, Soonchunhyang Bucheon Hospital, Soonchunhyang University College of Medicine, Bucheon, Korea
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Background Acquired bilateral nevus of Ota-like macules (ABNOM) are a common form of hyperpigmentation in Asian populations, characterized by brownish-blue or slate-gray pigmentation in the bilateral malar regions. The purpose of this study was to evaluate the efficacy and complications of a Q-switched (QS) fractional ruby laser in the treatment of ABNOM.
Methods Forty-four patients with ABNOM treated with a QS fractional ruby laser from January 2014 to February 2016 were enrolled in this study. Patients received up to 10 treatment sessions, at intervals ranging from 3 to 4 weeks. An automatic skin diagnosis system was used before and after laser treatment to evaluate the efficacy of the laser treatment. To evaluate the complications of the laser treatment, a retrospective chart review was conducted.
Results Forty-one patients were female, and 3 were male. The mean age of the patients was 47.2 years, and the mean follow-up period was 14 months. The median skin pigmentation score was 5 (interquartile range [IQR], 5–6) before laser treatment and 3 (IQR, 3–4) after laser treatment. A statistically significant difference ($P<0.01$) was found in the skin pigmentation score before and after laser treatment.
Conclusions This study suggests that, although multiple sessions are required, QS ruby fractional lasers can be considered an effective and less invasive form of treatment of ABNOM.

INTRODUCTION

Acquired bilateral nevus of Ota-like macules (ABNOM) are a common form of hyperpigmentation in Asian populations, characterized by small, bilateral, blue-brown and/or slate-gray patches on the forehead, temples, eyelids, malar areas, and alae and roots of the nose [1]. As reported in other studies, several treatment modalities, including cryotherapy and dermabrasion, have been tried for ABNOM [2,3]. Based on the principles of selective photothermolysis, nevus of Ota has been successfully treated with Q-switched (QS) ruby lasers, QS alexandrite lasers, and QS neodymium-doped yttrium aluminium garnet lasers (QS-Nd:YAG) [4-7]. ABNOM and nevus of Ota, are histologically similar, which suggested to us that laser therapy may also be successful for treating ABNOM. We therefore assessed the efficacy and complications of a fractional QS ruby laser (QSRL) in the treatment of ABNOM. The purpose of this study was to evaluate the efficacy and complications of QSRL in the treatment of ABNOM.

METHODS

Patients

Of the patients who underwent ABNOM treatment using a QSRL between January 2014 and February 2016, 44 patients who could be observed throughout a follow-up of longer than 12 months were enrolled in this study. Patients who had active systemic or local infections, local skin disease that might have altered wound healing, a history of psychiatric illness, or soft tissue augmentation material in face were excluded from this study.
Patients' medical charts and operative records were reviewed retrospectively to evaluate postoperative outcomes and complications. This study conformed to the Declaration of Helsinki. Written consent was obtained from each patient for the both the laser treatment and the publication of photographs of the results.

Pre-treatment preparation

In all patients, we applied a 5% lidocaine topical anesthetic ointment (Emla®; AstraZeneca AB, Karlskoga, Sweden) to the full facial area before the QSRL treatment. The topical anesthetic ointment was washed off with mild soap and water immediately before the procedure.

QSRL treatments

A total of 44 patients were treated with a QSRL (Melastar; Asclepion Laser Technologies, Jena, Germany), at a wavelength of 694 nm, a pulse duration of 25 ns, a spot size of 3 to 4 mm, and a fluence of 4.5 to 6 J/cm^2. The level of laser fluence was determined by the coloration of the lesion. The therapeutic endpoint was immediate whitening following laser irradiation. The energy density was reduced if tissue bleeding was prominent. Patients received up to 10 treatment sessions, at intervals ranging from 3 to 4 weeks.

Post-treatment care

After each laser treatment session, a topical antibiotic ointment was applied to the area irradiated by the QSRL. All patients were instructed to avoid direct sunlight and to apply a sunblock agent between laser treatment sessions in order to minimize post-inflammatory hyperpigmentation. A depigmentation cream, such as a 4% hydroquinone cream, was applied when post-laser hyperpigmentation occurred. The patients were instructed to visit in our hospital promptly if they encountered any other adverse effects.

Evaluation of outcomes

We evaluated the patients using an automatic skin diagnosis system (A-One Lite®; BOMTECH Electronics Co., Seoul, Korea) before treatment and 6 months after treatment. The automatic skin diagnosis system evaluated skin laxity using a scanner, and graded sagging and laxity on a scale from 1 to 6, with higher skin grade scores indicating more severe sagging and laxity. The A-One Lite scoring system comprehensively calculated a pigmentation score, including skin pore and sebum pigment condition. The clinician investigated color and possible hypopigmentation or hyperpigmentation after treatment.

Statistical analysis

Statistical analyses were performed using SPSS version 20.0 (IBM Corp., Armonk, NY, USA). The Friedman test was used to compare the skin test scores of patients before treatment and 6 months after treatment. All P-values of less than 0.05 were considered to indicate statistical significance.

RESULTS

Of the 44 patients who were treated using a QSRL, 41 were female and 3 were male (Table 1). The mean age of the patients was 47.2 years (range, 25–67 years) and the mean follow-up period was 14 months (range, 12–16 months).

The median skin grade score was 5 (interquartile range [IQR], 5–6) before treatment, and 3 (IQR, 3–4) 6 months after treatment (Fig. 1 and Table 2). This decrease in the skin grade score was statistically significant (P<0.01).

Major complications of QSRL treatment, such as scarring and post-inflammatory hyperpigmentation and hypopigmentation, were not observed during the follow-up period (Fig. 2-4). The most frequent minor complication was immediate mild erythema in the treated area. This transient erythema disappeared within 24 to 48 hours after treatment.

Table 1. Patients' characteristics

Characteristic	Value
Sex	
Female	41 (93.2%)
Male	3 (6.8%)
Age (year), mean (range)	47.2 (25–67)

Table 2. Skin pigmentation scores

Time	Pre-treatment (median)	Post-treatment (median)	P-value[a]
Skin pigmentation score	5 (IQR: 5–6)	3 (IQR: 3–4)	<0.01

IQR, interquartile range.
[a]P-value by Wilcoxon signed-rank test.

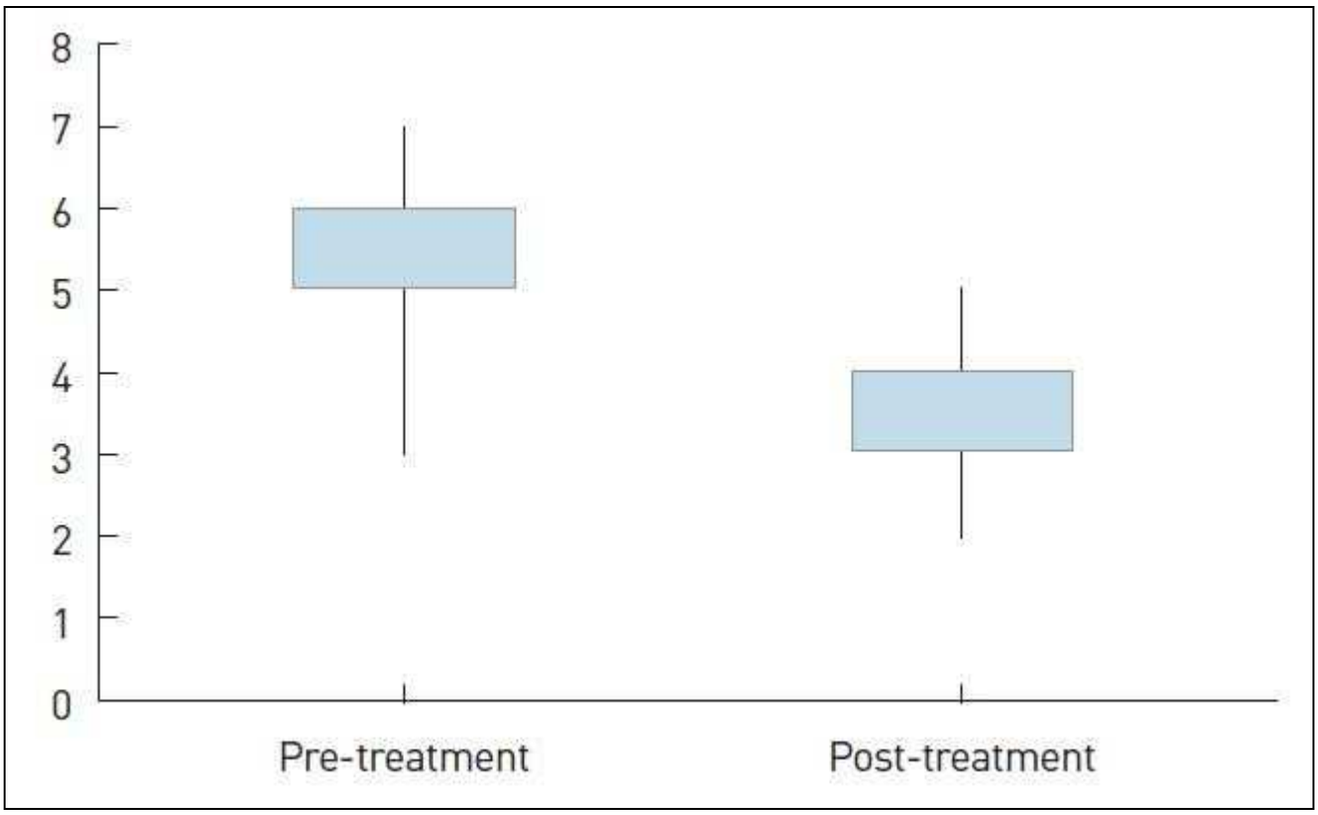

Fig. 1. The median skin grade score was 5 (interquartile range [IQR]: 5–6) before treatment, and the median skin grade score was 3 (IQR: 3–4) at 6 months after treatment.

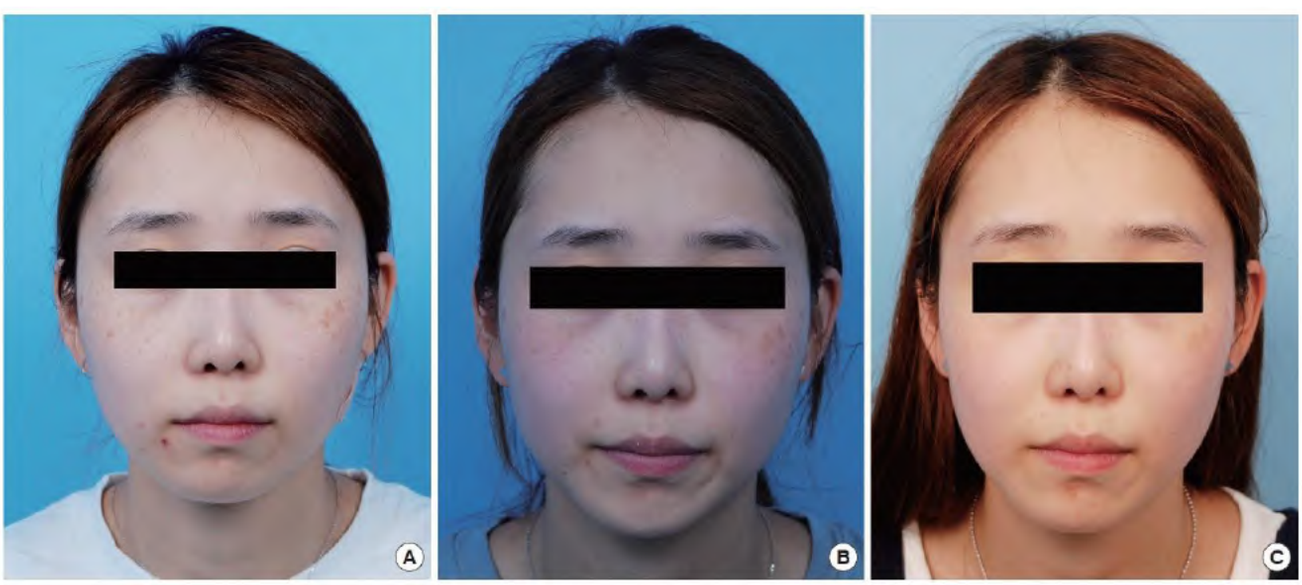

Fig. 2. A 26-year-old female patient with acquired bilateral nevus of Ota-like macules. (A) Before treatment, she was examined by the automatic skin diagnosis system and had a skin grade score of 6. (B) After 5 treatment sessions. (C) After the final treatment, her skin grade score was 2.

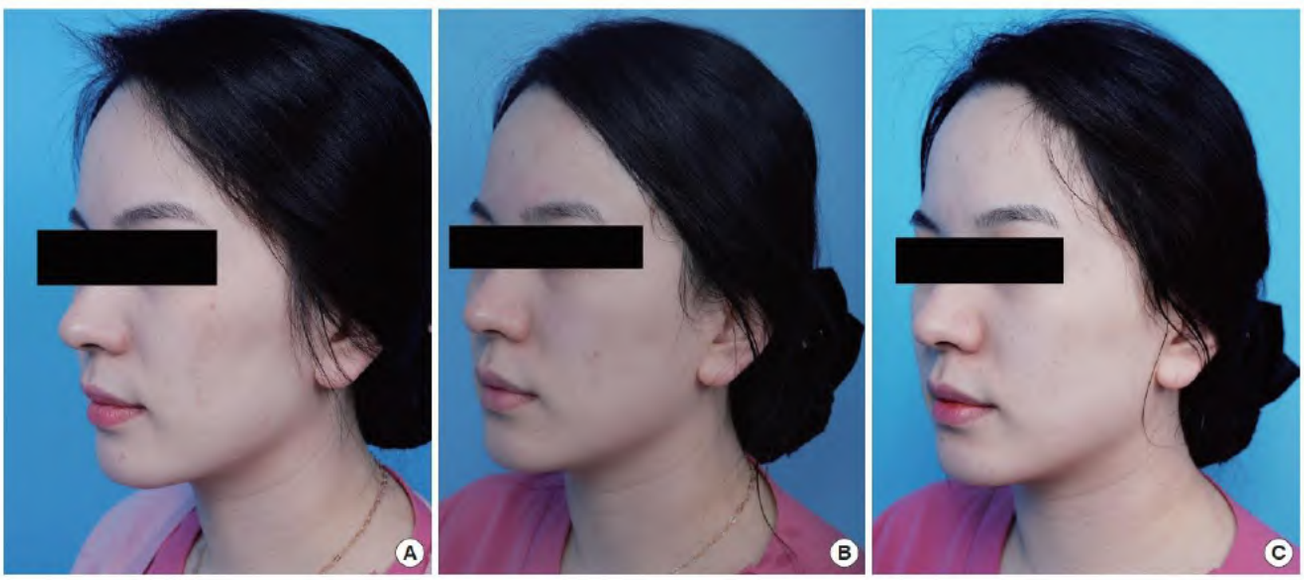

Fig. 3. A 33-year-old female patient with acquired bilateral nevus of Ota-like macules. (A) Before treatment, she was examined by the automatic skin diagnosis system and had a skin grade score of 5. (B) After 5 treatment sessions. (C) After the final treatment, her skin grade score was 3.

Fig. 4. A 48-year-old female patient with acquired bilateral nevus of Ota-like macules. (A) Before treatment, she was examined by the automatic skin diagnosis system and had a skin grade score of 6. (B) After the final treatment, her skin grade score A B was 4.

DISCUSSION

Hori et al. [1] initially described ABNOM, also referred to as Hori nevi, in 1984. ABNOM usually begin as discrete brown macules, which become confluent, slate-gray macules over time [8]. The malar region of the cheek is the most commonly affected site on the face.

It is important to clinically and histologically differentiate ABNOM from nevus of Ota and female facial melasma. Histologically, there are irregularly shaped, bipolar melanocytes dispersed in the papillary and mid-dermis regions, particularly in the subpapillary dermis, with no disturbance of the normal skin architecture. In contrast, melanocytes in nevus of Ota are distributed diffusely throughout the papillary and reticular dermis [9]. ABNOM are an acquired disorder, usually appearing at 40 to 50 years of age, and are usually bilateral. In contrast, nevus of Ota usually develops during the first year of life or during adolescence, is usually unilateral, and involves the conjunctival, oral, or nasal mucosae. Although dermabrasion has been successful in the treatment of ABNOM, this procedure is highly invasive and is associated with many complications, including scarring, infection, and post-inflammatory hyperpigmentation [3].

There are some differential diagnoses of ABNOM, especially in acquired cases with adult onset, such as melasma or lentigines, which are other adult-onset pigmentary disorders appearing on the face. These conditions show a variety of clinical features in terms of color, distribution, size, and onset.

Melasma is classified into epidermal, dermal, and mixed types by a Wood lamp examination. Recent histopathological studies, however, have denied the presence of dermal-type melasma. Most cases of dermal-type melasma, therefore, are considered to be ABNOM, Riel melanoses, or incontinentia pigmenti histologica, which show good response to QS laser treatment. Bilateral pigmented macules in patients with adult onset, such as ABNOM, are frequently misdiagnosed as melasma. Melasma appears only on sun-exposed areas, involving post-inflammatory pigmentation after sun exposure. In melasma, therefore, the periorbital area is never involved, and the alae of the nose or the root of the nose alone is very rare, although the pigment distribution is mostly symmetrical and similar to that of ABNOM. Melasma is usually well-demarcated and uniform in color, but rarely mottled. In ABNOM, however, the border is less clear, the color contains a blue or purple-brown tint, and the pigmentation is sometimes speckled. Melasma is exacerbated by sun exposure and ameliorated by long-term sun protection, while ABNOM is rarely influenced by sun exposure. The treatments for these conditions are very different; QS lasers are the only choice for the treatment of adult-onset dermal melanocytosis, while topical hydroquinone is one of the best choices for the treatment of melasma. Therefore, an accurate diagnosis is the key to successful treatment of these pigmented lesions.

Solar lentigines are usually macular lesions with a uniform shade of brown and have an irregular edge, although the size and color are variable. The distribution of ABNOM is symmetrical, but solar lentigines are not symmetrical and appear not only on the cheek, but also widely on sun-exposed areas. The border of ABNOM is less clear and the color of ABNOM contains a blue or purple-brown tint. In elderly patients, however, ABNOM can be associated with solar lentigines.

The QSRL was the first laser reported to be highly efficacious for the treatment of benign epidermal pigmented lesions [10]. The 694-nm wavelength allows for deeper penetration, thereby improving dermal pigmentation, as seen with nevus of Ota [11]. The 694-nm wavelength of QSRLs is more strongly absorbed and more selective for melanin than the wavelength of QS-Nd:YAG (1,064 nm), so QSRL is expected to be more effective than QS-Nd:YAG for the treatment of ABNOM. The collective experience of over 2 decades and the well-documented efficacy of QSRLs against epidermal and

dermal pigmentation make this laser an ideal first-line choice. Therefore, QS lasers are the main treatment method for both ABNOM and nevus of Ota. In a previous study, of patients undergoing 2-7 QS-Nd:YAG laser treatment sessions at intervals of 2 to 6 months, 30% to 100% showed an improved response, with differences in clinical responses due to differences in laser parameters and treatment intervals [12-14].

In our treatment, all patients who were treated for 10 sessions showed a higher than median skin grade score. We found a statistically significant correlation between the number of treatments and the therapeutic outcome. This means that clinicians need to consider repeated treatments for resolving ABNOM. We found no color or site-dependent differences in therapeutic outcomes. In contrast to several previous protocols, our repetitive treatment sessions were performed at 3 to 4 week intervals. This short interval time was chosen to improve the rate of clearing and to prevent epithelial repigmentation. Epidermal melanin and melanocytes are competing chromophores for dermal pigment laser therapy and increase the risk of post-inflammatory hyperpigmentation. By performing treatment sessions at short intervals, more photons can target the dermal chromophores through the hypopigmented epithelium, while avoiding scattering of the beam [15]. In addition, heat has little effect on the hypopigmented epidermis [16]. Although the pathogenesis of ABNOM is unclear, it may be due to epidermal melanocyte migration. This mechanism is consistent with the fact that the color of the macules varies with the maturity of the ABNOM. Initially, these macules are usually brown and discrete, becoming bluish-gray and diffuse over time. The early-stage brown lesions are thought to be due to the presence of melanocytes at the basal layer of the epidermis; their subsequent migration into the dermis leads to a darker bluish-gray color.

Hori macules, or ABNOM, have also been reported to variably respond to different lasers, including QSRL, QS-Nd:YAG, QS alexandrite, and a combination of a CO_2 laser and QSRL [12,14,17-19]. The variation in responses across studies, including ours, may be due to several factors. First, genetic and/or environmental differences among the wide-ranging populations in Asia may modulate the apparent responsiveness to treatment. Second, operator bias may affect the parameters of treatment; in other words, some surgeons may elect to start at a higher fluence or to escalate the dosage at a more rapid rate, thereby influencing the pace of clinical improvement. Third, selection bias may play a key role in defining patient outcomes. For instance, many of the patients with ABNOM reported by Kunachak and Leelaudomlip [12] had unsuccessful prior medical and procedural treatments, and therefore may have harbored more resistant disease than our population.

Fractional-mode lasers have some advantages. The fractional mode creates a number of microscopic treatment zones (MTZs) and spares the untreated areas between MTZs. These areas of adjacent viable tissue surrounding the MTZs allow for rapid healing, resulting in shorter recovery times [13,20]. Additionally, the side effects (hypopigmentation and hyperpigmentation) are less common than is seen after treatment with non-fractional lasers. In this study, the advantages of the fractional mode applied to the QSRL treatment, but multiple procedures per session and multiple treatment sessions are often required to achieve the desired clinical outcomes. This low-dose fractional-mode protocol may expose the skin to less total cumulative energy than the total toxic cumulative energy that destroys cells, leading to the lightening of ABNOM.

Our study had limitations. First, the post-treatment results were evaluated with an automatic skin diagnosis system, the reliability of which has not been established. Therefore, errors may have occurred in terms of how the automatic skin diagnosis system assessed the actual skin conditions.

Second, our study did not include a histologic evaluation. Therefore, further studies including a histologic analysis should be conducted, and we are planning such research. Third, our study used a fractional laser, so multiple treatment sessions were required. Despite these limitations, the significance of our study is that the efficacy of a QS 694-nm ruby fractional laser was proven through an objective analysis.

CONCLUSION

Although multiple sessions are required, we provide evidence that the use of multiple treatment sessions of a QS 694-nm ruby fractional laser can be an effective and less invasive strategy for the treatment of ABNOM. The length of follow-up after the final treatment was only 12 months, so long-term safety and efficacy follow-up studies of this treatment protocol are needed.

PATIENT CONSENT

Patients provided written consent for the use of their images.

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Treatment of melasma in Caucasian patients using a novel 694-nm Q-switched ruby fractional laser

Said Hilton, Heike Heise, Bettina Alexandra Buhren, Holger Schrumpf, Edwin Bölke and Peter Arne Gerber. Hilton et al. European Journal of Medical Research 2013, 18:43

Background

Melasma is a common hypermelanosis of the face. The use of a classical Q-switched ruby laser (QSRL) to treat melasma is discussed controversially and is associated with frequent adverse effects, such as hyper- or hypopigmentation. Recently a fractional-mode (FRx) QSRL was developed to minimize the adverse effects of classical QSRL. The objective of this research was to evaluate the efficacy and safety of a novel FRx-QSRL in the treatment of melasma in Caucasian patients.

Methods

We performed a retrospective study of 25 Caucasian melasma patients (Fitzpatrick skin types I to III). Patients received one to three FRx-QSRL treatments (TattooStar FRx, Asclepion Laser Technologies, Jena, Germany) at pulse energies of 4 to 8 J/cm^2. Three blinded investigators independently evaluated the melasma area and severity index (MASI) score before treatment and at the four- to six-week follow-ups. At additional three-month follow-ups, patients evaluated subjective improvement, pain and over-all satisfaction with the treatment according to a numeric analogue score (NAS). Side effects were documented.

Results

At four to six weeks post laser treatment for a mean of 1.4 sessions, we observed a significant (P = 0.0001) reduction of the MASI score from 6.54 to 1.98 (72.3%). Patients rated the pain of the intervention at a mean 2.46 points (0 = no pain; 10 = maximum pain), the improvement at a mean 5.55 points (0 = no improvement; 10 = maximum improvement) and the overall satisfaction at a mean 4.66 points (0 = not satisfied; 10 = maximum satisfaction). After three months, post-inflammatory hyperpigmentation (PIH) and/or recurring melasma were observed in 7 (28%) and 11 (44%) patients, respectively.

Conclusion

The 694-nm FRx-QSRL is a safe and effective option for treating melasma in Caucasian patients. Over periods of >3 months, PIH and/or recurring melasma may develop at significant rates and may reduce patient satisfaction. Multiple treatment sessions with lower pulse energies and/or a post-interventional therapy with hypopigmenting ointments and UV protection may help to minimize these complications.

Background

Melasma is a common acquired benign pigmentary disorder that classically manifests as symmetrical hypermelanosis of the face. Most commonly melasma affects women of reproductive age with darker skin types (Fitzpatrick skin types IV and higher) but it may also occur at other ages and in men. Briefly, the Fitzpatrick skin type classification system is based on the color of the skin (type I being the fairest (white) and type VI being the darkest (black)) and its response to UV exposure (pigmentation) [1]. An estimated more than five million people are affected by melasma in the United States of America alone [2]. Melasma has a significant negative impact on a patient's quality of life [3]. Risk factors include ultraviolet (UV) exposure, hormonal alterations (for example, pregnancy or oral contraceptives), thyroid disease and anti-seizure medication. Melasma that is related to pregnancy (or hormonal alterations) is also referred to as chloasma.

The pathogenesis of melasma has remained largely elusive. Established concepts propose a stimulation of pigment-producing cells (melanocytes) by sex hormones (estrogen and progesterone) and UV irradiation. Recent studies have reported paracrine effects amongst melanocytes, keratinocytes and/or fibroblasts [4-7], and have identified stem cell factor (SCF) and c-kit as pathogenic factors. The authors propose that UV irradiation induces SCF in dermal fibroblasts. Subsequently, the proliferation and melanogenesis of melanocytes is induced via SCF/c-kit-induced signaling [8]. Hypopigmenting topical agents containing hydroquinone, broad-spectrum UV protection and camouflage are considered the current standard of care for treating melasma. Additional therapeutic options include topical retinoic acids (tretinoin), azelaic acid, microdermabrasion, chemical peeling or electromagnetic devices, such as lasers [9-12].

Various laser and light systems, including ruby lasers, Er:YAG lasers, carbon dioxide (CO_2) lasers and intense pulsed light (IPL), have been evaluated for their efficacy in treating melasma [12-14]. IPL therapy effectively reduced the severity of melasma in a population of 89 Asian women [15]. The use of conventional ablative laser systems (Er:YAG and CO_2) for treating melasma has been reported to be associated with a significant frequency of post-interventional hyper- as well as hypopigmentation [16,17]. The frequency of adverse effects may be limited by using novel fractional laser systems [18]. Notably, several trials studying the effects of Q-switched ruby lasers (QSRLs) have reported controversial results. In 1994, Taylor and Anderson noted that QSRLs were ineffective for treating refractory melasma and post-inflammatory hyperpigmentation [19]. A split-face study by Tse *et al*. demonstrated that melasma patients developed post-inflammatory hyperpigmentation (PIH) and worsening of the melasma after QSRL therapy [20]. Conversely, a recent study by Jang *et al*. reported that a novel fractional-mode (FRx) QSRL (Tattoostar FRx, Asclepion Laser Technologies, Jena, Germany) may be effective in treating melasma in Korean patients [21].

Fractional photothermolysis has revolutionized laser resurfacing (LSR) and was initially presented by Manstein and coworkers in 2004 [22]. The significant adverse effects of classical LSR are significantly reduced by delivering the laser beam using a microarray. This technique creates microscopic columns of treated tissue and intervening areas of untreated skin, thereby allowing rapid re-epithelialization and minimal downtime. Fractional delivery has been developed for CO_2, Er:YAG, and yttrium scandium gallium garnet lasers [23]. Recently, a fractional-mode QSRL has been developed (Tattoostar FRx, Asclepion Laser Technologies, Jena, Germany), which can homogeneously deliver ruby laser microspots. The laser delivers a 7.1×7.1 mm^2 array of 196 microspots of 300 µm at a pulse duration of 40 ns, with an overall coverage of 27.7%. This approach may minimize the adverse effects of classical QSRL, such as PIH and hypopigmentation. Here, we present a retrospective analysis of 25 Caucasian patients, which assesses the efficacy of an FRx-QSRL in treating melasma.

Methods

Patients

In the study, 25 Caucasian women (mean age 39.8 years; range 31 to 57; Fitzpatrick skin types I to III) with melasma were treated with an FRx-QSRL (TattooStar FRx, Asclepion Laser Technologies, Jena, Germany) at the Medical Skin Center, Düsseldorf, in 2010 and 2011. Patients presented with epidermal or mixed-type melasma. Of the patients, 19 had had melasma <10 years and 6 had had it >10 years. The melasma areas were located on the forehead ($n = 14$), the cheeks ($n = 12$), the chin ($n = 2$) or the upper lip ($n = 2$). Identified risk factors included past pregnancies ($n = 5$), hormonal therapy ($n = 12$) and UV exposure ($n = 25$). Some patients presented with melasma in multiple locations and/or risk factors.

Treatment

We used a 694-nm FRx-QSRL (Tattoostar FRx, Asclepion Laser Technologies, Jena, Germany) at fluences of 4 to 8 J/cm^2 and a frequency of 1 Hz. For each individual patient, the fluence was gradually increased to identify the minimal fluence needed to achieve a clinical effect (photosdisruption). Each patient received laser treatment for all affected areas. In pain-sensitive patients, a topical anesthetic (a lidocaine-tetracaine mix) was applied onto the treated areas 30 minutes prior to treatment. However, most patients tolerated the intervention without anesthesia. The laser treatment lasted up to 10 minutes depending on the size and number of treated areas. Post-intervention, cool packs were applied. Patients were advised to use strict UV protection. If more than one treatment was needed, the patient received additional treatments after intervals of four weeks.

Evaluation

Photographs (Canon EOS 40D digital camera, Tokyo Japan) were taken before therapy and at the four- to six-week follow-up sessions. Three blinded investigators independently evaluated the melasma area and severity index (MASI) score before treatment and at the four- to six-week follow-ups, as previously described [24]. At the additional three-month follow-ups, patients evaluated subjective improvement, pain and their overall satisfaction with the treatment was determined according to a numeric analogue score (NAS). At this time point, side effects were documented.

Statistical analysis

Student's T-test was used for the statistical analysis, and $P < 0.05$ was regarded as statistically significant.

Results

The analysis included 25 patients. At the follow-up at four to six weeks after the last treatment (there were up to three treatment sessions with a mean of 1.4 sessions) the average MASI score showed a significant reduction from 6.54 to 1.98 (72.3%) (Figures 1 and and2).2). In general, the adverse effects for the first days post therapy were mild and included erythema, a burning sensation, pruritus and exfoliation. After three months, PIH and/or recurring melasma were observed in 7 (28%) and 11 (44%) patients, respectively.

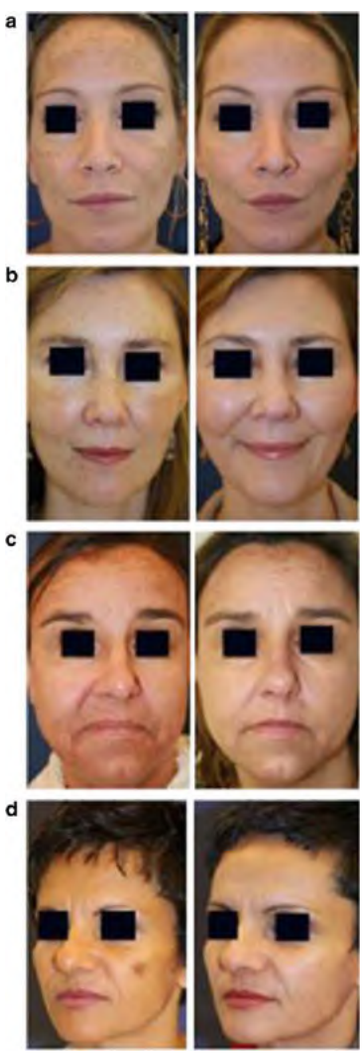

Figure 1

Melasma in Caucasian patients before and four to six weeks after one treatment with the 694-nm FRx-QSRL. (a) 39-year old woman, fluence 6 J/cm^2, front: 2 passes, cheeks: 1 pass. **(b)** 42-year-old woman, fluence 6 J/cm^2, 1 pass. **(c)** 51-year-old woman, fluence 6 J/cm^2, 2 passes. (d) 42-year-old woman, fluence 5 J/cm^2, 1 pass. Presented cases are representative examples of the 25 treated patients. FRx, fractional-mode; QSRL, Q-switched ruby laser.

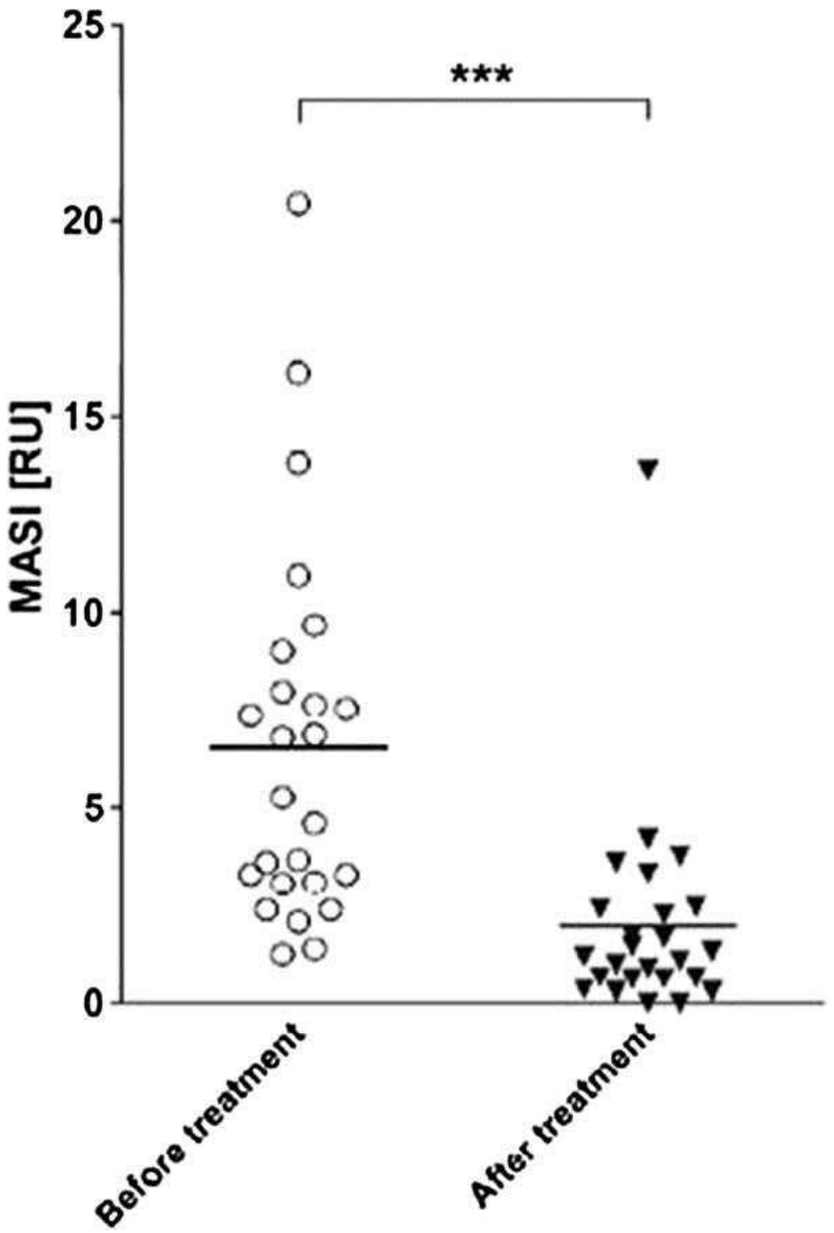

Figure 2

Melasma area and severity index (MASI) scores before and four to six weeks after the final treatment with the 694-nm FRx-QSRL. Values are plotted as individual ratios and mean ratios are shown by the horizontal bar (*** $P \leq 0.0005$). FRx, fractional-mode; QSRL, Q-switched ruby laser.

The patients' self-evaluation rated the pain of the intervention at a mean 2.46 points (0 = no pain; 10 = maximum pain), the improvement at a mean 5.55 points (0 = no improvement; 10 = maximum improvement) and the overall satisfaction at a mean 4.66 points (0 = not satisfied; 10 = maximum satisfaction). We also used the same protocol to treat patients with darker skin types and melasma and/or PIH, with satisfactory results (Figure 3).

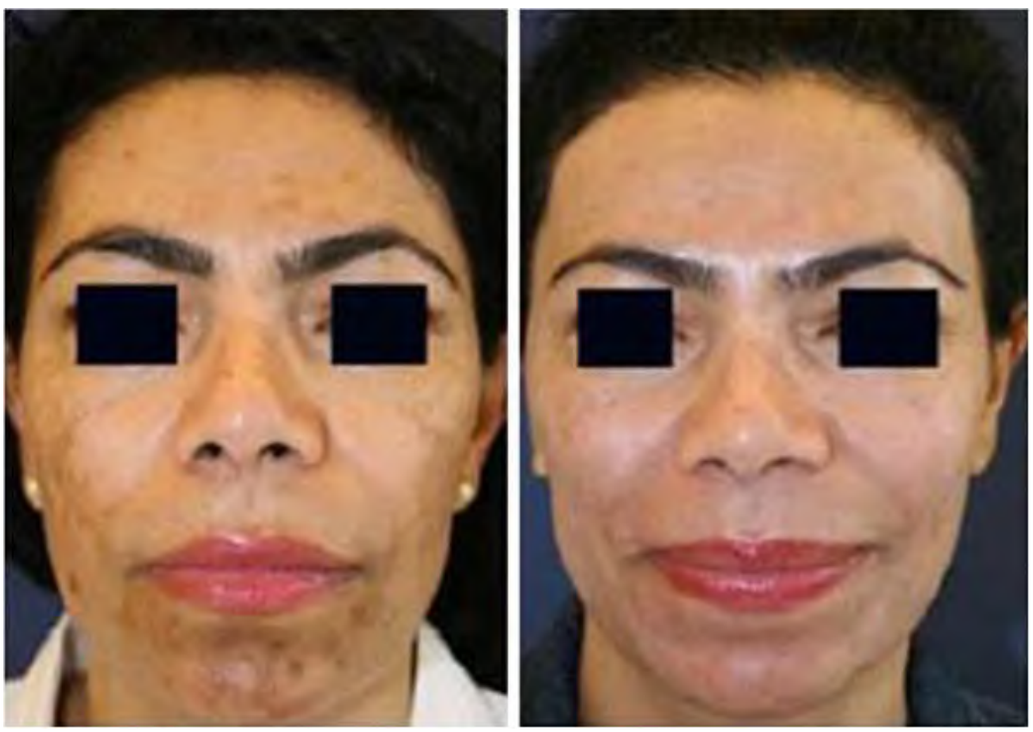

Figure 3

Melasma in an African patient before and 12 weeks after the final treatment with the 694-nm FRx-QSRL. 50-year old woman; first session: fluence 6 J/cm^2, 1 pass; second session: fluence 7 J/cm^2, 1 pass. The patient applied a combination of topical bleaching agents and strict UV protection for the documented 12 post-intervention weeks. FRx, fractional-mode; QSRL, Q-switched ruby laser.

Discussion

Laser therapy is based on the biophysical principle of selective photothermolysis. The lasers used emit light at a wavelength that is specifically and adequately absorbed by the target chromophores [25]. The target chromophore for pigmented lesions is melanin. Laser light that is adequately absorbed by melanin includes that from ruby (694 nm), Nd:YAG (523 and 1064 nm) and alexandrite (755 nm) lasers. Q-switched (QS) lasers generate a rapid burst of light, which matches the thermal relaxation time for melanin, thereby effectively destroying the pigment [14].

QS-Nd:YAG lasers have been shown to be effective and are widely used in the management of melasma [26-29]. A representative recent study by Zhou *et al*. of 50 patients (Fitzpatrick skin types IV to VI) demonstrated a mean decrease in the MASI score of 61.3% after nine sessions. At the three-month follow-up a recurrence rate of 64% was noted [29]. A study of 50 patients by Sim *et al*. reported improvement rates of 50% to 74% [28]. For the QSRL, earlier reports state that the laser is ineffective for melasma or may even worsen the pigmentation after therapy [19,20]. Conversely, a recent study by Jang *et al*. demonstrated a mean decrease of the MASI score of 29.8% in 15 Korean patients after six treatments with an FRx-QSRL (TattooStar FRx, Asclepion Laser Technologies, Jena, Germany). Two patients reported a slight worsening. None of the patients reported any long-term adverse effects such as PIH [21]. Jang *et al*. found that a QSRL was more effective for treating melasma compared to a QS-Nd:YAG laser [21]. This has been demonstrated by comparative studies

for other pigmented lesions, such as nevus of Ota, lentigo, PIH and Becker's nevus, and it is proposed that this is due to the stronger absorption of the 694-nm wavelength light (QSRL) by melanin compared to 1064-nm wavelength light (QS-Nd:YAG) [20,21,30].
Consistent with the results of Jang *et al*., we have demonstrated a significant ($P = 0.0001$) decrease of the MASI score of 72.3% in 25 Caucasian patients after a mean of 1.4 sessions with an FRx-QSRL (TattooStar FRx, Asclepion Laser Technologies, Jena, Germany). As the risk of common adverse effects of QSRL therapy, such as PIH, is expected to be significantly lower in Caucasian compared to Asian skin types, we applied higher fluences (4 to 8 J/cm^2) per session compared to Jang *et al*. (2 to 3 J/cm^2). However, this more aggressive treatment resulted in a significantly higher rate of adverse effects (PIH and/or recurring melasma in 28% and 44% of the patients). Lower fluences and multiple treatment sessions may reduce the frequency of these adverse effects. However, many patients refuse further treatment (and want to avoid additional costs) if the result of an initial treatment is minimal. An additional option could be a multimodal therapy using an FRx-QSRL in combination with microdermabrasion [27], chemical peeling [31] and/or hypopigmenting topical agents [32].

Conclusions

In summary, the FRx-QSRL is a safe and effective treatment for melasma for patients with Caucasian or Asian skin types. Multimodal concepts may further increase the efficacy and reduce the adverse effects of the therapy. We maintained only a three-month follow-up after the final treatment, so further long-term studies are needed.

Consent

Written informed consent was obtained from the patients for the publication of this report and any accompanying images.

Abbreviations

FRx: Fractional-mode; IPL: Intense pulsed light; LSR: Laser resurfacing; MASI: Melasma area and severity index; PIH: Post-inflammatory hyperpigmentation; QS: Q-switched; QSRL: Q-switched ruby laser; SCF: Stem cell factor.

Competing interests

PA Gerber received honoraria for oral presentations by Asclepion Laser Technologies.

Authors` contributions

SH and HH performed the laser treatments and collected the data. BAB, HS, EB and PAG evaluated and analyzed the data, and wrote the manuscript. All authors read and approved the final manuscript.

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Fractional mode Q-switched Ruby Laser for Melasma

Dr. Paisal Rummaneethorn, Bangkok, Thailand

Introduction

Fractional mode lasers were built for reducing unwanted side effects and downtime associated with a faster healing process. As a result of the method the average downtime can be greatly reduced from 2 weeks into only 2-3 days.

Q-switched Ruby Lasers are used for treating superficial and dermal pigmentary disorders since 1990. There were comparison studies between Q-switched Ruby Laser, Q-switched Nd:YAG Laser and Q-switched Alexandrite Laser. The well known photoacoustic mechanism of a Q-switched Ruby Laser cause effective diminishing and lightening of tattoos.

Melasma is a common oriental hormonal related hyperpigmentation. It is aggravated by sun exposure. The UV can cause melanocytic hyperfunction. Up to now several laser and light based systems have been used to lighten melasma such as Q-switched Nd:YAG Laser, Fractional Er:Glass Laser and IPL (Intense Pulsed Light).

Patients and Methods

From January 2010 until May 2010 we treated 14 cases of refractory melasma with a new fractional mode Q-switched Ruby Laser from Asclepion Laser Technologies.

The patients stopped the use of bleaching creams for at least 4 weeks before the laser treatment. We used a special designed handpiece for the treatment which provides a precise fractional pattern mode of 14 x 14 dot`s. The spot size is 7.1 x 7.1 mm. The diameter of each single dot is 300 microns. The area coverage is 27.7%.

A fluence of 2-3.5 J/cm^2 were utilized in order to prevent photothermal reaction. We treated the whole area or whole cheeks. EMLA has been applied as a local anesthesia 40 minutes prior to the treatment in order to reduce any patients discomfort. Photo evaluation and documentation has been performed before and one month after. We used the improvement scale of grade 1,2,3,4 as 0-25%, 25-50%, 50-75%, more than 75% improvement respectively. The side effects and complications such as postinflammatory hyperpigmentation, marked erythema, scarring will be shown.

Results

We found grade 1 improvement of 5 patients (41.7%), grade 2-3improvement of 7 patients (58.3%) of 12 patients. There were 2 patients lost during the follow up. There were 3 cases of postinflammatory hyperpigmentation. There were no scarring observed due to the low fluence settings used.

Discussion

From a study for IPL treatment for melasma with 4 treatment sessions every 4 weeks. The patients in the intense pulsed light group achieved an average of 39.8% improvement in relative melanin index, compared to 11.6% improvement in the control group ($p<0.05$) at Week 16. Six (35%) patients in the intense pulsed light group had more than 50% improvement, compared to two (14%) patients in the control group.

For our study we found a remarkable improvement after a single treatment with the new fractional Ruby system. Optimal effective fluences are still to be investigated within further studies. We need to treat a larger group of patients and perform biopsies in order to optimize treatment protocols.

Conclusion

It is expected that a series of 2 or 3 fractional Q-switched Ruby Laser treatments can be a very effective method which could significantly improve the treatment of Melasma.

Use of a Fractional Q-Switched Ruby Laser for Treatment of Facial Lentigines

Lisa K. Chipps, MD, MS; Joseph W. Diehl; Jonathan M. Schouest, BS; Ronald L. Moy, MD
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Introduction: Fractional laser technology is associated with decreased post treatment morbidity but has not been applied to Q-switched ruby lasers (694 nm). Standard Q-switched ruby lasers have been used effectively for the treatment of pigmented lesions but require postoperative wound care and significant recovery time. The objective is to report on the suitability of a new fractional handpiece for a Q-switched ruby laser for the treatment of facial lentigines.

Materials and Methods: Five patients with facial lentigines were treated with or without topical anesthetic with a fractional Q-switched ruby laser at a fluence that caused tissue whitening.

Results: Patients were treated 1 to 2 times. All patients experienced clinical improvement in hyperpigmentation with minimal post treatment erythema and crusting.

Conclusions: The fractional Q-switched ruby laser is an ideal treatment for facial lentigines, causing clinical improvement with minimal post treatment morbidity.

Fractional technology with many lasers has offered the ability to achieve significant clinical results with decreased recovery time and post treatment morbidity, but this has not yet been applied to Q-switched ruby lasers for the treatment of pigmented lesions.1 Here we report the use of a fractional Q-switched ruby laser for the treatment of facial lentigines. Solar lentigines are benign hyperpigmented macules that tend to gradually increase in size and number on sun-exposed parts of the body, affecting more than 90% of the Caucasian population over 50 years of age.2 A variety of ablative and nonablative lasers are available for their treatment. The Q-switched ruby (694 nm, 25–40 nsec) laser has been effective in treating many pigmented epidermal and dermal lesions, including lentigines.3

Figure 1. New fractional handpiece attached to the Q-switched ruby TattooStar laser (Asclepion Laser Technologies) that was used in this study.

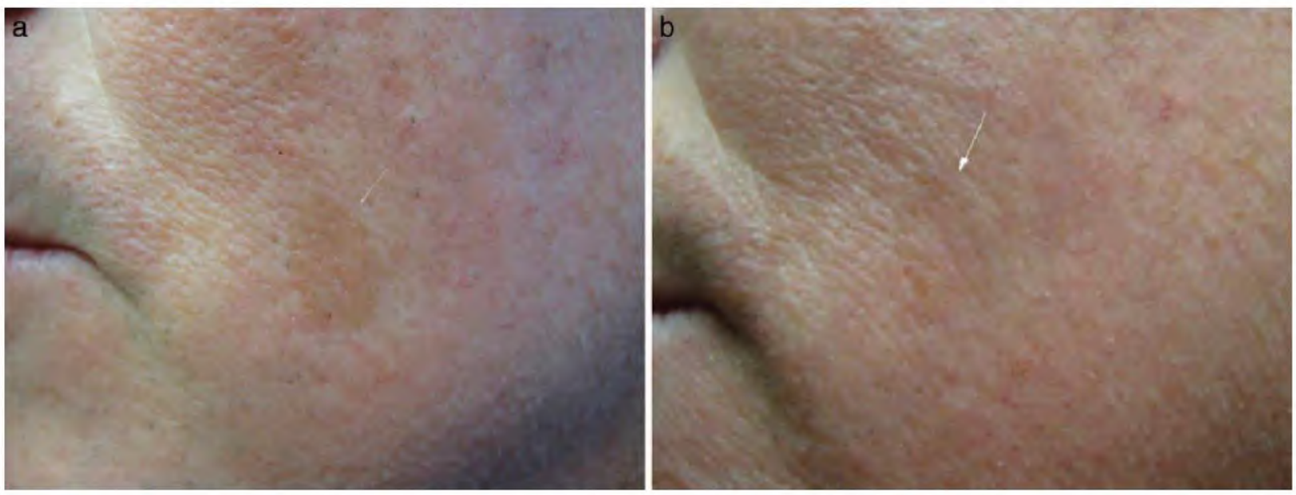

Figure 2. Case 1, solar lentigo, left cheek, (a) before and (b) after 1 treatment with fractional ruby laser.

With fractional lasers, the generation of many small columns of treatment zones of a controlled width and depth allows for rapid wound healing around the small surface area of injury, drawing from healthy keratinocytes in the surrounding skin. In skin resurfacing lasers, post treatment erythema is present in both fractional and nonfractional treatments but tends to be of markedly shorter duration with fractional treatment. Another advantage of fractional lasers is a decreased rate of postinflammatory hyperpigmentation compared to nonfractional treatment.4 In our experience, fractional lasers also cause less pain and have less downtime than their counterparts, although more treatments are sometimes required. If also applicable to the fractional Q-switched ruby laser, these characteristics could make it a viable alternative for treatment of solar lentigines.

Materials and Methods

A new fractional handpiece was attached to a Q-switched ruby (694 nm) TattooStar laser (Asclepion Laser Technologies) (Figure 1). The spot size was 7.1 × 7.1 mm, with a spot pattern of 14 × 14. The size of each microspot was 300 µm, with a gap of 200 µm, yielding a total coverage of 27.7% surface area. The fluence measurements on the TattooStar base unit (calibrated for a solid 4-mm diameter spot) do not correspond exactly with the fractional handpiece, as the base machine's range of 2.5 to 9 J/cm^2 correlates to a fluence of 2.24 to 8.16 J/cm^2 (information provided by Asclepion).

Facial lentigines from patients in our private practice were selected for treatment with this new handpiece for this laser, which is approved for removal of tattoos and benign pigmented lesions. The diagnosis of benign lentigo was made clinically by a board-certified dermatologist prior to treatment. Target areas were cleaned and makeup was removed. After patients signed written informed consent, the lesions to be treated were photographed. When requested by the patient, a topical anesthetic (benzocaine 4%, lidocaine 4%, and tetracaine 4%) was applied 10 to 30 minutes prior to treatment and washed off immediately prior to treatment. No intradermal anesthetic was needed for these treatments.

For each lesion, the treatment was started with a low fluence and then titrated up to tissue response, to a maximum fluence of 9 J/cm^2. Each lesion was treated with several overlapping pulses until clinically uniform tissue whitening was achieved. After treatment, emollient (Aquaphor) was applied. Patients were instructed to apply sunscreen to the area daily until healed. No bandages were necessary.

Results

Subjects (n = 5) aged 38–73 years with facial lentigines were treated 1 to 2 times. At low settings (4.0 to 4.5 J/cm^2), no appreciable tissue response was observed. At higher settings (6.0–8.5 J/cm^2), pinpoint spots of tissue whitening could be appreciated.

Case 1

A 59-year-old man, Fitzpatrick skin type II, with a single lentigo on the left check was treated 1 time with a fluence of 8.0 J/cm^2 (Figure 2). No topical anesthetic was used. The patient tolerated the procedure well, and he did not experience any crusting or residual erythema after 1 week. The lentigo lightened significantly, and the patient did not desire further treatment.

Case 2

A 55-year-old woman, Fitzpatrick skin type II, with multiple lentigines on the face was treated 1 time with a fluence of 8.0 J/cm^2 (Figure 3). No topical anesthetic was used. The patient tolerated the procedure well. After 1 week, there was a small of amount of crusting, which subsequently resolved without scarring. Clinical improvement was noted on follow-up.

Case 3

A 73-year-old woman, Fitzpatrick skin type II, with multiple lentigines on the face was treated with 3 passes of the laser with a fluence of 8.0 J/cm^2 (Figure 4). No topical anesthetic was applied, and the patient tolerated the procedure well. There was no residual erythema or crusting at 1 week, and the patient was satisfied with the result.

Case 4

A 38-year-old woman, Fitzpatrick skin type II, with multiple lentigines on the face was treated initially with a fluence of 5.0 J/cm^2 (Figure 5). Topical anesthetic (benzocaine 4%, lidocaine 4%, and tetracaine 4%) was applied, and the patient tolerated the procedure well. Significant improvement was noted at 1 week. The patient had a second treatment 6 weeks later with a fluence of 8.0 J/cm^2, with further improvement, and no crusting or prolonged erythema.

Case 5

A 63-year-old woman, Fitzpatrick skin type II, with a lentigo above the lip was treated with a fluence of 8.5 J/cm^2 (Figure 6). No topical anesthetic was used, and the patient tolerated the procedure well. On follow-up visit, the patient felt the lesion had cleared completely and desired no further treatment.

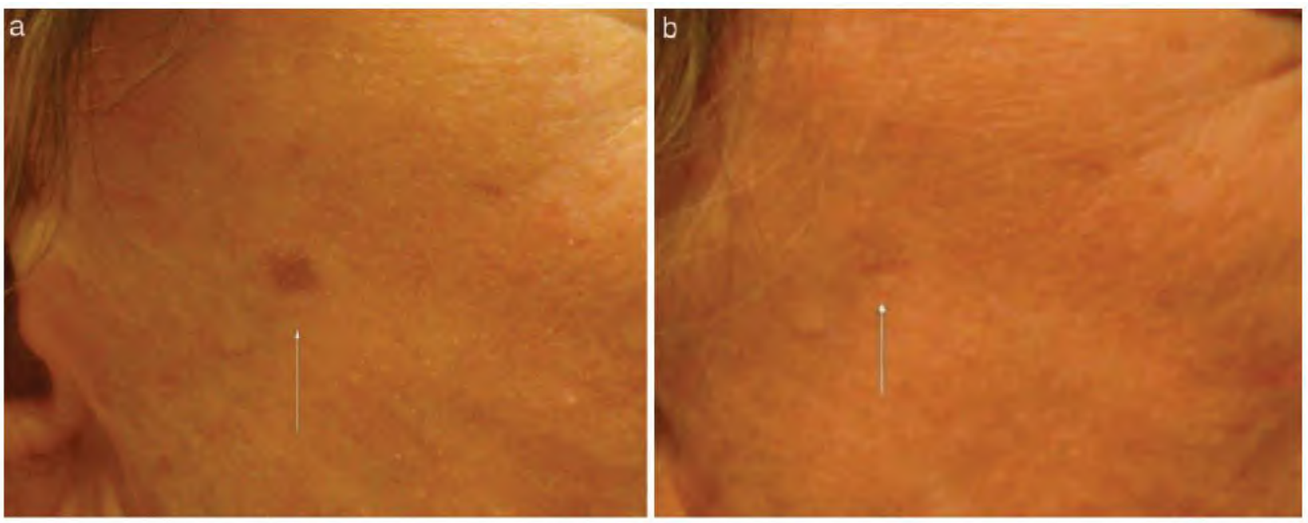

Figure 3. Case 2, solar lentigo, right cheek (c) before and (d) after 1 treatment with fractional ruby laser.

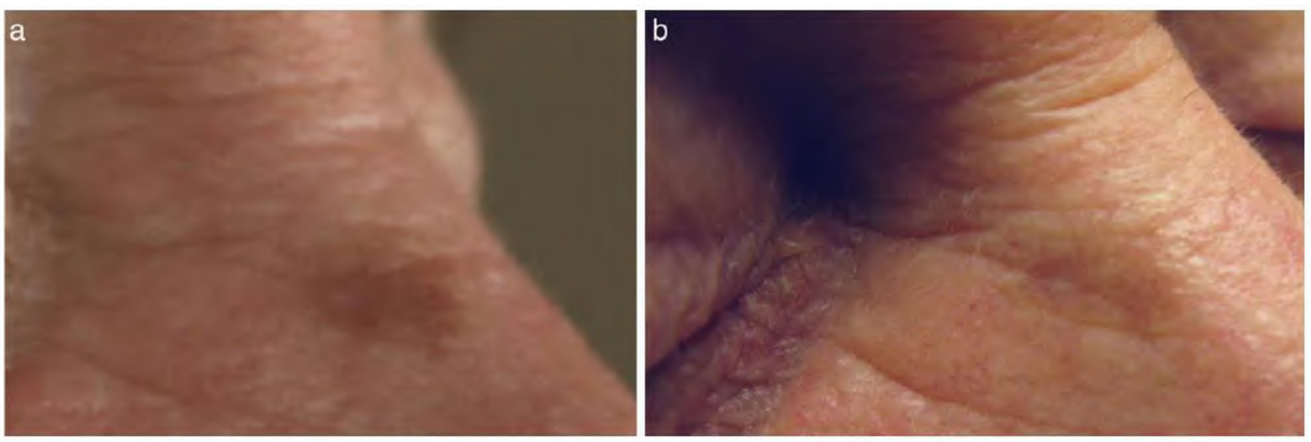

Figure 4. Case 3, solar lentigo, nasal bridge, (a) before and (b) after 1 treatment with fractional ruby laser.

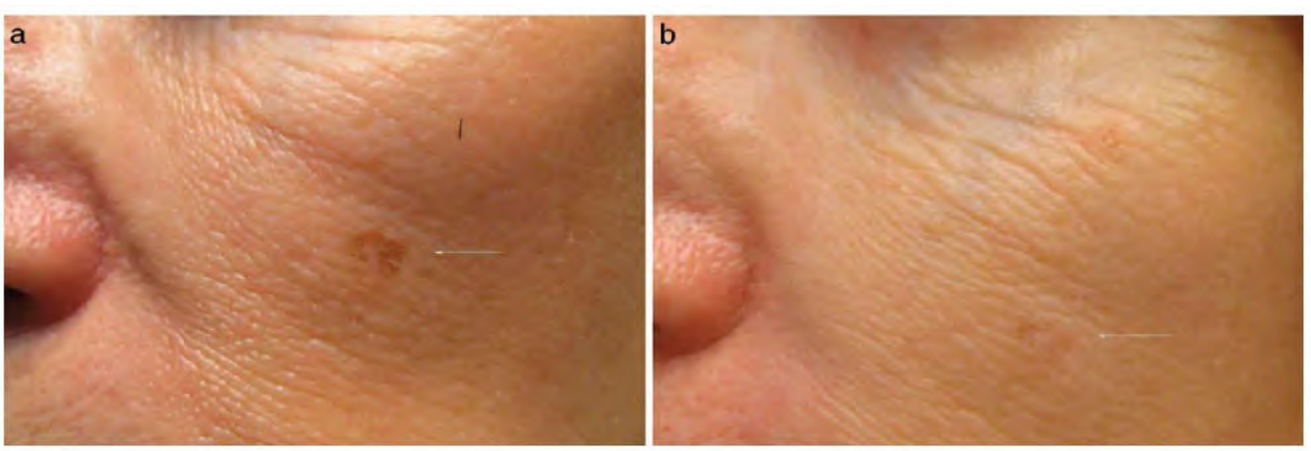

Figure 5. Case 4, solar lentigo, left cheek (a) before and (b) after 2 treatments with fractional ruby laser.

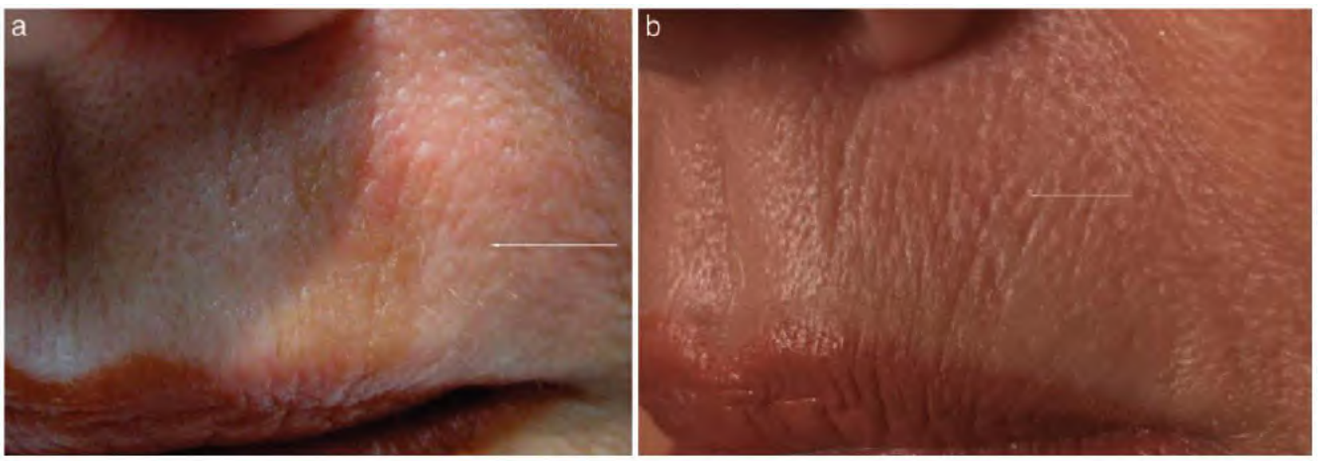

Figure 6. Case 5, solar lentigo, left upper lip, (a) before and (b) after 1 treatment with fractional ruby laser.

Conclusions

We noted significant clinical improvement in fairskinned patients presenting for treatment of facial lentigines with a fractional handpiece for the Q-switched ruby laser. Overall, we found rapid healing times with erythema that typically resolved in less than 4 days. Only 1 patient had residual signs of postprocedural erythema or crusting at 1 week, which subsequently healed without scarring. In contrast to the standard Q-switched ruby laser, wound care was not necessary for these patients. They were able to use sunscreen and make-up immediately after treatment for concealment of erythema. None of these patients experienced postinflammatory hyperpigmentation or scarring.

We report the fractional handpiece for the Q-switched ruby laser as a valuable modality in the treatment of facial lentigines. This treatment is well-tolerated without anesthetic or with only topical anesthetic, and without significant post treatment erythema or crusting.

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Efficacy of 694-nm Q-switched ruby fractional laser treatment of melasma in female Korean patients

WOO SUN JANG*, CHANG KYUN LEE**, BEOM JOON KIM*, AND MYEUNG NAM KIM*
* Department of Dermatology, College of Medicine, Chung-Ang University, Seoul, Korea;
** Gowoonsesang Dermatologic Clinic, Seoul, Korea
Dermatol Surg. 2011 Aug;37(8):1133-40

BACKGROUND:
Melasma is a common acquired symmetrical hypermelanosis of sun-exposed areas of the skin. Although the classical Q-switched ruby laser (QSRL) has been used successfully for the removal of tattoos and for the treatment of cutaneous pigmented lesions, its efficacy for melasma remains controversial.

OBJECTIVE:
We used repeat low-dose fractional QSRL treatment for melasma and analyzed the clinical results.

METHODS:
Fifteen Korean women with melasma were enrolled. Each patient received six low-dose fractional QSRL treatments to the face at 2-week intervals. Two investigators independently evaluated Melasma Area and Severity Index (MASI) scores before each session and 4 and 16 weeks after the final session. The intensities of pigmentation and erythema were assessed by measuring skin reflectance using a tristimulus color analyzer.

RESULTS:
Mean MASI score decreased from 15.1 ± 3.3 before treatment to 10.6 ± 3.9 16 weeks after the final treatment. The lightness of pigmentation (L-value) increased from 56.6 ± 3.5 before treatment to 59.9 ± 2.8 16 weeks after the final treatment.

CONCLUSIONS:
Multiple treatment sessions of low-dose fractional QSRL may be an effective strategy for the treatment of dermal or mixed-type melasma.

Comparison of fractional Q-switched ruby laser combined with a fixed hydroquinone combination versus the cream alone in the treatment of Malar or Mandibular Melasma in Asians: A pilot study

Paisal Rummaneethorn MD,

ABSTRACT:

RUMMANEETHORN P. Comparison of fractional Q-switched ruby laser combined with a fixed hydroquinone combination versus the cream alone in the treatment of Malar or Mandibular Melasma in Asians: A pilot study.

DEPARTMENT OF DERMATOLOGY, SCHOOL OF ANTI-AGING AND REGENERATIVE MEDICINE, MAE FAH LUANG UNIVERSITY, BANGKOK, THAILAND

Background: Treatments for melasma nowadays have some therapeutic effects but are often unsuccessful for refractory melasma. Topical medications need long therapeutic treatment period with potential side effects. However, the use of laser in the treatment of melasma is still controversial. The theoretically nearly-Ideal for targeting melanin pigment, and also fractional mode which is expected to have homogeneous energy to produce less tissue Injury, and less adverse effects (eg. PIH) compared to the conventional QSRL. This new technology of QSRL may be another main treatment for melasma or co-intervention to boost the faster treatment, and to reduce the use of hydroquinone and adverse effects of current topical medication.

Objective: To study the efficacy and adverse effect of Fractional Mode Q-swithed Ruby Laser in the treatment of malar or mandibular melasma in Asians.

Materials and Methods: 40 patients with malar or mandibular melasma were treated using fractional Q-switched ruby laser (Tattostar®, Asclepion) combined with a topical fixed hydroquinone combination (0.01% Fluocinolone acetonide, 4% Hydroquinone, 0.05% Tretinoin) on one side during 3 treatment sessions at 1-month interval, compared with a fixed hydroquinone combination alone on the other side. Patients were followed up for 2-months after last treatment. Clinical outcomes were evaluated by photographs from Reveal camera, Melanin Index by Mexameter MX 18, and patient satisfaction questionnaire before and after 3 treatment sessions.

Results: The initial results after 2 laser sessions found that there is a significant improvement of melasma 46.58% compared to the baseline measured by the mexameter . The improvement rate in the laser side was 53.20% compared to 50.16% in the non-laser side, but not statistically significant (p=0.685). We also found that though the melasma was much improved in the first laser treatment, there was no significant improvement in the second laser treatment compared to the first laser treatment . However on the third laser treatment we have found the on the laser treated side has further improvement compared to the non laser treated side which might be the rebound (p=0.08). Subjective evaluation by patient satisfaction questionnaire showed significantly higher scores in the laser side compared to the non-laser side (p=0.03).

Conclusion: Fractional Q-switched ruby laser has some roles in the treatment of facial melasma especially in the first and second treatment session without any serious side effects. And the improvement of melasma after the third laser treatment, or the maintenance effect of the laser to decrease the recurrence of melasma has been shown.

Key words: Melasma, Hydroquinone, Ruby Laser, Fractional Q-switched Ruby Laser

Studies Book

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Asclepion Laser Technologies GmbH
Brüsseler Str. 10 • 07747 Jena, Germany
www.asclepion.com