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Orijinal Araştırma

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Efficacy and safety of long-pulsed alexandrite laser for the treatment of solar lentigines

Solar lentigo tedavisinde uzun atımlı alexandrite lazerin etkinlik ve güvenilirliği

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Abstract

Background and Design: Various lasers, mainly nanosecond Q-switched (QS), and picosecond lasers, have been successfully used to treat solar lentigines. However, picosecond lasers are expensive, and QS lasers have a higher risk of post-inflammatory hyperpigmentation (PIH) in darker skin types. The aim of our study is to examine retrospectively the efficacy and safety of long-pulsed alexandrite laser in the treatment of solar lentigines, compare our findings to previous studies with nano and pico-second lasers, and evaluate long-term outcomes regarding recurrence.
Materials and Methods: We retrospectively analyzed 39 patients with a clinical diagnosis of solar lentigo treated by long pulsed alexandrite laser. Patients' photographs and clinical charts were reviewed in terms of demographic features, areas of treatment, number of sessions, laser settings, recurrence of lesions, Fitzpatrick's skin type, and any side effects observed.
Results: The rate of improvement was excellent in 33 (84.6%), moderate in 4 (10.3%), and mild in 2 (5.1%) patients. Seven (17,9%) patients with Fitzpatrick's skin type III and IV developed PIH. Lesion recurrence was observed in 5 patients (12.8%). Mean time to recurrence was 57.98±4.45 months.
Conclusion: Our study suggests that long pulsed alexandrite laser is an effective and safe option in the treatment of solar lentigines.
Keywords: Solar lentigo, solar lentigo treatment, solar lentigines, alexandrite laser

Öz

Amaç: Solar lentigo tedavisinde nanosaniye Q-anahtarlı (QA) ve pikosaniye (PS) lazerler başta olmak üzere pek çok lazerin başarılı olduğu bildirilmiştir. Ancak PS lazerler çok pahalı sistemlerdir. QA lazerler ise koyu tenli hastalarda yüksek post-enflamatuvar hiperpigmentasyon (PİH) riskine sahiptir. Çalışmamızın amacı, solar lentigo tedavisinde uzun atımlı alexandrite lazerin etkinlik ve güvenilirliğini incelemek, sonuçlarımızı nano- ve piko-saniye lazer kullanılan mevcut çalışmalarla karşılaştırmak ve rekürrens açısından uzun dönemli sonuçlarını bildirmektir.
Gereç ve Yöntem: Klinik olarak solar lentigo tanısı nedeniyle uzun atımlı alexandrite lazer uygulanmış 39 hasta retrospektif olarak analiz edildi. Hasta dosyaları ve fotoğrafları; demografik özellikler, tedavi bölgeleri, seans sayısı, lazer parametreleri, lezyonların rekürrensi, Fitzpatrick deri tipi ve yan etkiler açısından gözden geçirildi.
Bulgular: İyileşme derecesi 33 (%84,6) hastada mükemmel, 4 (%10,3) hastada orta ve 2 (%5,1) hastada hafif olarak değerlendirildi. PİH, Fitzpatrick deri tipi III ve IV olan 7 (%17,9) hastada gelişti. Beş (%12,8) hastada lentigo lezyonları nüksetti. Nükse kadar geçen süre ortalama 57,98±4,45 ay olarak hesaplandı.
Sonuç: Çalışmamız, uzun atımlı alexandrite lazerin solar lentigo tedavisinde etkili ve güvenilir bir tedavi seçeneği olduğunu göstermektedir.
Anahtar Kelimeler: Solar lentigo, solar lentigo tedavisi, solar lentijinler, alexandrite lazer

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Introduction

Solar lentigines are benign, hyperpigmented macular lesions that usually arise on sun-exposed regions, such as the face and dorsal surfaces of hands and forearms. They occur because of melanocyte proliferation in the basal layer and increased melanin production. Lesions may be solitary or multiple and range in size from less than a millimeter to several centimeters[1].

There is a strong correlation between the prevalence of solar lentigines and increasing age, affecting over 90% of white people older than 50 years of age[2].

Due to the wide absorption spectrum by melanin, various types of lasers, mainly the Q-switched (QS) and picosecond (PS) lasers, have been reported to treat solar lentigines with success[3]. However, the risk of post-inflammatory hyperpigmentation (PIH) with QS lasers in darker skin types is high, reaching up to 47%[4]. Few studies exist in the literature regarding the long-pulsed alexandrite laser (LPAL) to treat solar lentigines. Besides, the follow-up of lesions after treatment was short or not available, and the recurrence rates were not reported after the treatment[5-8].

The aim of our study is to examine retrospectively the efficacy and safety of LPAL in the treatment of solar lentigines, compare our findings to previous studies using nano and pico-second lasers, and evaluate long-term outcomes regarding recurrence.

Materials and Methods

Patients

We retrospectively analyzed 39 patients with a clinical diagnosis of solar lentigo treated by LPAL (Apogee+, Cynosure, Westford, MA) between October 2013 and April 2022. Patients' photographs and clinical charts were reviewed in terms of demographic features, areas of treatment, number of sessions, laser settings, recurrence of lesions, Fitzpatrick skin type, and any side effects observed. Except for crusting, side effects and complications, such as prolonged erythema, vesicle formation, pigmentation, depigmentation, scar or keloid formation, and ulceration, were included in the analysis.

Exclusion criteria included pregnancy, patients with a history of keloids or hypertrophic scars, active infection in the area of treatment, and history of photosensitivity or photosensitive epilepsy.

Our study was approved by the Ethics Committee of Haliç University (approval number: 226, date: 30.11.2022). Informed consent was obtained.

Laser treatment

Before treatment, all cosmetics were removed by washing the patients' treatment areas, and ethyl alcohol 70% was applied for antisepsis.

Solar lentigines were treated by a single physician (Ş.S.G.) using a 5 mm spot size, 5 msec pulse duration, and 35-50 joule/cm^2 fluence. Cold air (Zimmer Elektromedizin, Ulm, Germany) was applied to reduce thermal damage and patient discomfort during treatment. Fluence was adjusted according to pigmentation, i.e., the lighter the pigmentation, the higher the fluence. Treatment endpoints were defined as darkening, whitish or grey discoloration, and dissociation of the lesioned skin immediately after laser pulses. An average of 1-5 laser shots were used to reach the endpoint. No topical anesthesia was used.

Following treatment, a cream containing copper sulfate, sucralfate, zinc oxide, and zinc sulfate (Avene Cicalfate®) was used to improve healing and recommended to continue twice a day until scabs fell off. Retinoic acid 0.1% cream twice a week and sunblock were prescribed to decrease the risk of PIH. Makeup was allowed starting from the next day if the area of treatment was dry with no signs of serum leakage.

Follow-up visits were made after 1, 4, and 8 weeks. Treatment efficacy and side effects were retrospectively evaluated by another dermatologist (S.K.) comparing before and after photographs (8 weeks). Pigment clearance was rated using a 4-grade percentage improvement scale: no or poor improvement (<25%), mild improvement (26-50%), moderate improvement (51-75%), or excellent improvement (76-100%).

Statistical Analysis

To analyze the data descriptive statistics, including mean, standard deviation, lowest, highest, frequency, and percentage values were used. In patients whose lesions recurred, Kaplan-Meier analysis is used to calculate the recurrence-free period of lesions.

Results

There were 35 women (89.7%) and 4 men (10.3%), ranging in age from 30 to 75 years (mean: 53.1). The Fitzpatrick skin types in the study were type II (n=17), III (n=20), and IV (n=2). Lentigo lesions were on the face (n=33), hands (n=5), and back (n=1). The number of sessions was 1 in 29 (74%) patients, while a second treatment was needed in 10 (26%). The median follow-up of patients was 16 (range: 2-105) months.

The rate of improvement was excellent in 33 (84.6%), moderate in 4 (10.2%), and mild in 2 (5.1%) patients (Figure 1). Lesion recurrence was observed in 5 patients (12.8%), with a median time to recurrence of 60 months (mean time to recurrence was 57.98±4.45 months).

PIH was developed in 7 (18%) patients with Fitzpatrick skin types III and IV. Patients were advised to continue retinoic acid cream twice a week until pigmentation disappeared completely (mean 9.7±3.5 weeks). None of the patients experienced ulceration, scarring, or keloid formation. The demographic characteristics and findings of the patients are summarized in Table 1.

Discussion

Few studies examined LPAL in the treatment of solar lentigines more than a decade ago, and there is a paucity of studies on this issue[5-8]. Previous studies using LPAL reported conflicting results related to efficacy and safety. Rosenbach et al.[5] observed excellent or complete clearance in 90% of patients and only two cases of hypopigmentation as a side effect. However, Ho et al.[6] found no significant improvement and a 20% rate of PIH after LPAL. The risk of PIH was between 0 and 20% in these studies. Hypopigmentation and erosions were additional complications noted[5-8].

Melanosomes are the main target to treat solar lentigines. An ideal laser for solar lentigo can be defined as one that selectively targets melanosomes without damaging the surrounding tissue. In this context, QS lasers and PS lasers can be thought of as the treatment of choice for this indication due to shorter pulse widths than the thermal relaxation time of the melanosomes. In addition, it was suggested

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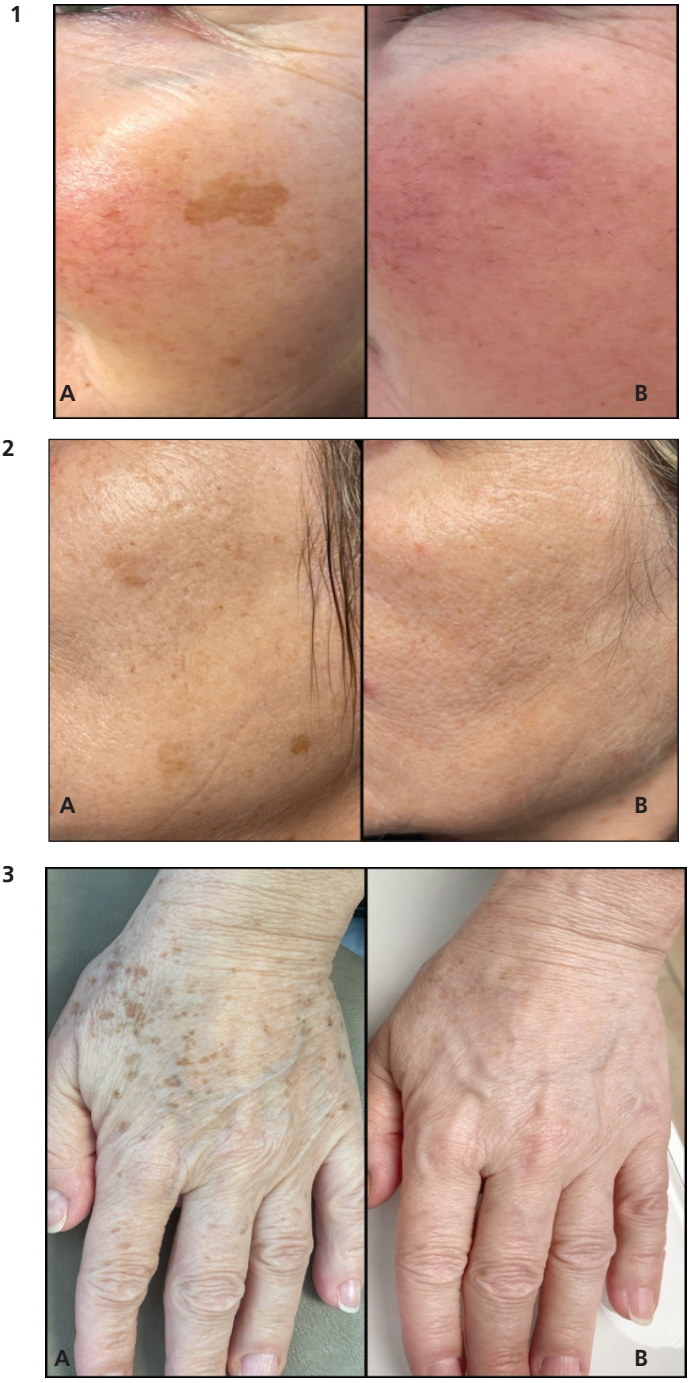

Figure 1. Patients treated by Alexandrite laser for solar lentigo lesions **(A)** before treatment, **(B)** after treatment. 1: Solitary lentigo on left cheek; 2: Multiple lentigo lesions on left cheek; 3: Multiple lentigo lesions on dorsum of the left hand

that long pulsed lasers destroy tissue only through a photothermal effect but the QSNL through both photothermal and photomechanical reactions[7]. However, the authors have been using LPAL to treat lentigos effectively for several years with minimal side effects and downtime.

Table 1. Patient demographic features and findings

Patient characteristics	N: Number (%)
Total patient number	39 (100%)
Sex	
Female	35 (90%)
Male	4 (10%)
Mean age (year)	53.1
Fitzpatrick's skin type	
II	17 (44%)
III	20 (51%)
IV	2 (5%)
Number of sessions	
1	29 (74%)
2	10 (26%)
Rate of improvement	
Excellent (76-100%)	33 (84.6%)
Moderate (51-75%)	4 (10.2%)
Mild (25-50%)	2 (5.1%)
Poor (<25%)	0
Postinflammatory hyperpigmentation (PIH) Average PIH duration to improve (week)	7 (17.9%); 9.7±3.5
Recurrence	
Number of patients	5 (12.8%)
Recurrence free interval (month)	60 (57.98±4.45)

Therefore, besides investigating the efficacy and side effects associated with the LPAL, the present study also aimed to compare findings to the literature reported with QS and PS lasers.

Anderson et al.[9] were the first to demonstrate the effectiveness of a QS neodymium-doped yttrium aluminum garnet (Nd:YAG) laser in the treatment of cutaneous pigmentation. Because of the high absorption coefficient for melanin, QS nanosecond lasers have been more preferably and widely used for the pigmented lesions with satisfactory results. In darker skin types, the risk of PIH is reported to be around 25% to 47%[4,10,11] in lentigines. The inflammatory response, because of photothermal damage to surrounding hemoglobin and melanin, was claimed for developing PIH[6,12].

Ho et al.[7], compared QS Alexandrite and LPAL to treat freckles and lentigines in 20 Chinese patients (Fitzpatrick skin type III-V) in a prospective study. Although both types of lasers were effective for the treatment of these epidermal lesions, PIH was more frequently observed after QS treatment (22%), compared to LPAL treatment (6%)[7]. The low risk of PIH observed with LPAL was related to more absorption by target melanin and minimal absorption by the competing chromophores, i.e., oxyhemoglobin resulting in limited injury to pigment-laden structures[13]. These findings are comparable to previous studies carried out predominantly on lighter-skinned Type II patients, with a lower risk of PIH, compared to darker skin types[5,8].

Compared to QS lasers, PS lasers were reported to have a higher efficacy and lower incidence of side effects. PS lasers produce a

greater photomechanical effect but less heat diffusion, resulting in limited photothermal damage to surrounding structures[12]. Negishi et al.[14] treated 20 Asian (Fitzpatrick type III and IV) patients with solar lentigo using PS Nd:YAG laser at 532-nm and forty lesions (93.02%), achieving over 75% clearance with a single treatment. PIH was observed in 3 (15%) patients and 3 lesions (4.65%). Kauvar et al.[15] reported 20% (4/20) PIH with a ≥50% clearance in 73% of treatment areas at 12 weeks. Interestingly, most patients who completed the study (88%) had Fitzpatrick skin type II[15]. When the literature regarding the treatment of lentigines using PS lasers is examined, we can see that some studies with a low incidence of side effects reported the rates, taking account of the number of lesions or sessions instead of a number of patients[10,14]. For example, Guss et al.[10] reported 0.8% of PIH in 2/255 lesions in patients treated by PS laser. However, when we consider the number of patients (1/6), PIH rate is calculated as 17%. Similarly, Chan et al.[16] reported that PIH was observed in 10% of 137 sessions (14/137), which corresponds to 25% of patients in their study. Our study demonstrated over 75% improvement in 89% of patients treated for solar lentigines with a PIH rate of 18%. Mild clearance (26-50%) was only seen in two patients. The color of these lesions was light brown, which was considered a cause. This was emphasized by Trafeli et al.,[8] who pointed out that patients with darker lentigines achieved the greatest lesion clearance. Therefore, light-colored lentigines should be thought of as poor candidates for LPAL treatment.

It should also be emphasized that over 50% of the study group (59%) comprised type III and IV patients with a higher risk of PIH. But the observed rate of PIH was similar or lower compared to some of the previous studies with QS or PS lasers[4,7,10,11,14-16]. None of our patients had hypopigmentation or prolonged erythema reported with QS or PS lasers[14,17,18]. These results suggest LPAL is comparable to QS and PS lasers in terms of efficacy and safety in the treatment of solar lentigines. To the best of our knowledge, our study is the first to report long-term follow-up results regarding the rate of recurrence after treating solar lentiginosis. We observed that, although clinically, lesions are improved, some lesions 5 (12.8%) relapsed. Mean time to recurrence was 57.98±4.45 months. Therefore, before treatment, patients should be informed about the possibility of recurrence and followed up even if the lesions cleared completely.

Study Limitations

The retrospective design of our study is the first limitation. The sample size can be small, and follow-up time can be considered short. Future studies with larger groups of participants and longer follow-ups are needed to confirm our findings.

Conclusion

Our study suggests LPAL is an effective and safe option in the treatment of solar lentigines. It should be considered among the first choice of treatments in this indication besides nanosecond and PS lasers.

Ethics

Ethics Committee Approval: Study was approved by the Ethics Committee of Haliç University (approval number: 226, date: 30.11.2022).

Informed Consent: Informed consent was obtained.

Peer-review: Externally peer-reviewed.

Authorship Contributions

Concept: Ş.S.G., S.K., Design: Ş.S.G., S.K., Data Collection or Processing: Ş.S.G., Analysis or Interpretation: S.K., Literature Search: Ş.S.G., S.K., Writing: Ş.S.G.

Conflict of Interest: The authors declare that they have no conflict of interest.

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