Case Report
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MEDICAL LASERS
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Sequential Delivery of Neodymium:Yttrium-Aluminum-Garnet and Alexandrite Laser Pulses for Treating Light Brown Seborrheic Keratoses

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Seborrheic keratoses (SKs) have been treated with non-ablative long-pulsed (LP) lasers, including LP 532-nm neodymium (Nd): yttrium aluminum garnet (YAG), LP 695-nm ruby, LP 755-nm alexandrite (Alex), and LP 1,064-nm Nd:YAG lasers, with a pulse durations of 1-300 msec. Dual-wavelength LP 755-nm Alex/1,064-nm Nd:YAG laser systems have been used to remove hair follicles and treat various vascular and pigmented disorders by sequentially delivering two pulses of different wavelengths with interpulse intervals in the millisecond range. This paper reports the case of a female patient with multiple, discrete, light brown SKs on the dorsum of both hands that were treated effectively with one session of dual-wavelength LP 1,064-nm Nd:YAG/755-nm Alex laser treatment. The treatment settings for the LP Nd:YAG laser were comprised of a wavelength of 1,064 nm, fluence of 50 J/cm^2, pulse duration of 5 msec, and beam size of 3 mm. The settings for the LP Alex laser were comprised of a wavelength of 755 nm, fluence of 50 J/cm^2, pulse duration of 5 msec, and beam size of 3 mm. A hybrid mode was used to automatically deliver LP Nd:YAG and LP Alex laser pulses in succession at interpulse intervals of 20 msec. Six weeks after treatment, the patient exhibited remarkable improvement of the light brown seborrheic keratoses and was satisfied with the results.

Key words
Laser; Neodymium-doped yttrium aluminum garnet; Alexandrite; Long pulse; Seborrheic keratosis

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INTRODUCTION

Seborrheic keratoses (SKs) have been treated with chemical or mechanical peelings and ablative lasers. However, a high risk of side effects, particularly prolonged post-treatment erythema and dyspigmentation, limit the use of ablative procedures in Asian patients with large SKs. Thus, non-ablative long-pulsed (LP) lasers, including LP 532-nm neodymium (Nd): yttrium aluminum garnet (YAG), LP 695-nm ruby, and LP 755-nm alexandrite (Alex), LP 1,064-nm Nd:YAG lasers, at pulse durations of 1-300 msec have been additionally or alternatively used for treating SKs.[1,2]

With lower absorption coefficients to melanin and oxyhemoglobin, 1,064-nm Nd:YAG lasers show lower therapeutic efficacy for treating epidermal pigmentation lesions, although they pose a lower risk of side effects in Asian patients, compared to 532-nm Nd:YAG lasers. Moreover, the penetrability of 1,064-nm Nd:YAG lasers is higher than that of 532-nm Nd:YAG or 755-nm Alex lasers, and 1,064-nm Nd:YAG lasers can treat deeper part of the skin. Nonetheless, LP 1,064-nm Nd:YAG lasers usually present low therapeutic efficacy in the treatment of lightly pigmented lesions.[3] Meanwhile, with higher absorption coefficient to melanin and lower absorption coefficient to water than 1,064-nm Nd:YAG lasers, LP 755-nm Alex lasers are more effective in destroying nests of pigmented lesions. However, the use of LP 755-nm Alex has been limited by the high risk of postinflammatory dyschromia and scarring in dark-skinned or tanned patients.[3]

Dual-wavelength LP laser systems in a single platform, such as a 595-nm pulsed-dye laser/1,064-nm Nd:YAG laser or 755-nm Alex/1,064-nm Nd:YAG laser system, have been used to enhance therapeutic efficacy and safety.[3,4] Particularly, LP 755-nm Alex/1,064-nm Nd:YAG laser systems have been used for removing hair follicles and treating various vascular and pigmented disorders by sequentially delivering two pulses of different wavelengths at interpulse intervals in the millisecond range.[3] However, the optimized treatment settings of dual-wavelength LP lasers according to target lesions have not been evaluated. In this report, we demonstrate a female patient with multiple, discrete, light brown SKs on the dorsum of both hands that were effectively treated with one session of dual-wavelength LP 1,064-nm Nd:YAG/755-nm Alex laser treatment at 20-msec interpulse intervals.

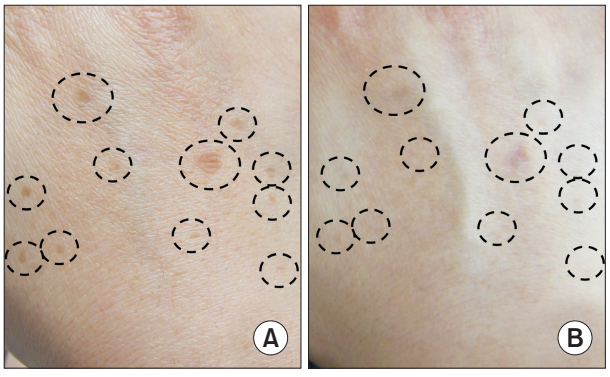

Fig. 1. Photographs of the dorsum of the right hand with light brown seborrheic keratoses (A) at baseline and (B) at six weeks after one session of dual-wavelength long-pulsed (LP) 1,064-nm neodymium (Nd):yttrium-aluminum-garnet (YAG)/755-nm alexandrite (Alex) laser treatment. The lesions were treated with a single pulse of LP Nd:YAG laser at a fluence of 50 J/cm^2, a pulse duration of 5 msec, and a beam size of 3 mm, followed by a single pulse of LP Alex laser at a fluence of 50 J/cm^2, a pulse duration of 5 msec, and a beam size of 3 mm, using a hybrid mode at a 20-msec interpulse interval (Nd:YAG-20-Alex).

CASE REPORTS

A 45-year-old Korean female visited our clinic presenting with multiple light brownish papular lesions on the dorsum of hands (Fig. 1A and 2A). She had no remarkable family history or medical history. The patient had never been treated with oral and topical retinoids, chemical or mechanical peelings, or ablative or non-ablative lasers for the pigmented lesions on the hands. Dermoscope (DermLite ProII; 3Gen Inc., San Juan Capistrano, CA, USA) evaluation of the lesions exhibited homogeneous, flat, and slightly elevated light-brown fat fingers. Accordingly, the lesions were clinically diagnosed with light brown seborrheic keratoses.

After obtaining written informed consent, the patient

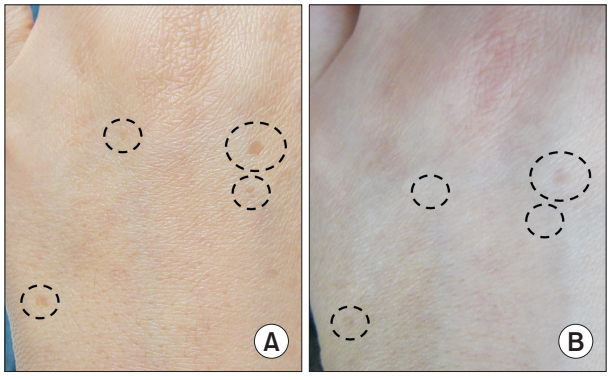

Fig. 2. Photographs of the dorsum of the left hand with light brown-colored seborrheic keratoses (A) at baseline and (B) at six weeks after one session of dual-wavelength LP Nd:YAG-20-Alex treatment.

was treated with a single session of dual-wavelength LP 1,064-nm Nd:YAG/755-nm Alex laser treatment (SANDRO Dual; WONTECH Co., Ltd., Daejeon, Korea). The dorsum of the hands was cleansed with 70% ethanol, and topical anesthetic cream (eutectic mixture of 2.5% lidocaine HCl and 2.5% prilocaine, EMLA; Astra Pharmaceuticals, Westborough, MA, USA) was applied under occlusion for 1 hour. The treatment settings for the LP Nd:YAG laser comprised a wavelength of 1,064 nm, a fluence of 50 J/cm^2, a pulse duration of 5 msec, and a beam size of 3 mm, while those for the LP Alex laser comprised a wavelength of 755 nm, a fluence of 50 J/cm^2, a pulse duration of 5 msec, and a beam size of 3 mm. A hybrid mode was used to automatically deliver LP Nd:YAG and LP Alex laser pulses in succession at an interpulse interval of 20 msec (Nd:YAG-20-Alex). The single pass of Nd:YAG-20-Alex treatment was delivered to the light brown-colored seborrheic keratoses with 10%-20% overlapping using neither a dynamic cooling device nor air cooling device. Immediately after sequential dual-wavelength treatment, the treated areas were cooled with icepacks. No occlusive dressings, prophylactic systemic or topical corticosteroids, or antibiotics were used. The patient was recommended to avoid excessive scrubbing and sun exposure.

Pain during the Nd:YAG-20-Alex treatment was tolerable, and immediately after the treatment, the lesions were slightly edematous and darkened with mild erythematous skin changes. Brownish to black crusts became noticeable on the treated lesions at post-treatment 1 day and fell off spontaneously at post-treatment day 7 to 10. Six weeks after the treatment, the patient exhibited remarkable improvement in the appearance of the light brown seborrheic keratoses: the patient was very satisfied with the results (Fig. 1B and 2B). No remarkable major side effects, including itching, crusts, oozing, burn, prolonged edema, postinflammatory hypo- or hyperpigmentation, and scarring, were encountered other than mild post-treatment erythema or residual pigmentation of a few lesions.

DISCUSSION

Long-pulsed lasers show high efficacy over a short procedure time by destroying nests of pigmented lesions rather than by targeting individual pigment chromophores; they also pose a low risk of side effects during the treatment of various pigmentary disorders.[2,5] Our study group previously analyzed a total of 216 SK lesions on the face that were treated with one or three sessions of LP 755-nm Alex laser treatment at a 35-J/cm^2 fluence , a 6-mm spot size, and a 3-ms pulse width over 1-2 passes at 1-month intervals.[2] Therein, irradiated SKs exhibited the appearance of fine bubbles and became crusted within a few days thereafter, which spontaneously fell off within 7 days.[2] The required number of treatment sessions for satisfactory clinical outcomes were significantly associated with the morphologic factors of SKs, but not the type and color factors.[2] Nonetheless, no conclusive reports have demonstrated the optimized parameter settings of LP lasers for treating SKs.

Dual-wavelength laser systems in a single platform irradiate laser pulses at two different wavelengths for achieving better clinical outcomes. Thereby, target lesions can be treated by delivering laser pulses at each of the wavelengths alone or by irradiating simultaneous or sequential laser pulses at both wavelengths. Furthermore, sequential delivering technology, which has been incorporated into dual-wavelength LP laser systems, allows clinicians to irradiate both wavelengths at interpulse intervals in the millisecond range. Therein, the first pulse at one of the available wavelengths induces chromophore alterations, and the second pulse at the other wavelength generates enhanced photoacoustic and photothermal reactions.[6]

Dual-wavelength LP 755-nm Alex/1,064-nm Nd:YAG laser systems have been used for treating vascular and pigmentary disorders and for hair removal. The wavelengths can be chosen according to the characteristics of target lesions among 755 nm alone, 1,064 nm alone, 755 nm followed by 1,064 nm, and 1,064 nm followed by 755 nm, considering the penetration depths and absorption coefficients thereof. A split-lesion, comparison study revealed that the sequential delivery of Nd:YAG-Alex subpulses or vice versa removed axillary hairs as effectively and as safely as LP 755-nm Alex laser treatment alone.[7] The disadvantages of high-fluenced LP 755-nm Alex laser treatment alone in Asian patients include post-treatment hypo- or hyperpigmentation, whereas those of high-fluenced LP 1,064-nm Nd:YAG laser treatment alone include the risk of excessive heat accumulation in the deep dermis.[7] Therefore, we suggest that pretreatment of pigmentary disorders using a LP 1,064-nm Nd:YAG laser that is followed by LP 755-nm Alex laser treatment can enhance the therapeutic efficacy and safety of the latter LP laser treatment.

Our previous study demonstrated that light brown SKs on the face can be treated well with LP 755-nm Alex laser treatment.[2] In our experience, however, the treatment outcomes after LP 755-nm Alex laser treatment

for lightly pigmented papular SKs on the dorsum of the hands or forearms are unsatisfactory. In these cases, ablative lasers, including 10,600-nm carbon dioxide and 2,940-nm erbium:YAG laser, have been reluctantly used as an additional or alternative treatment modality, despite the high risk of prolonged post-treatment erythema and dyspigmentation in Asian patients.

In this study, we demonstrated that multiple, discrete, light brown-colored SK lesions on the dorsum of hands could be effectively treated with one session of dual-wavelength LP 1,064-nm Nd:YAG/755-nm Alex laser treatment at a 20-msec interpulse interval. We deemed that the first pulse of the LP 1,064-nm Nd:YAG laser partially destroyed SK lesions and also altered the characteristics of chromophore therein. Furthermore, the photoacoustic and photothermal effects by the following LP 755-nm Alex laser pulse on LP 1,064-nm Nd:YAG-pretreated SK lesions were enhanced. We also considered that a short interpulse interval of 20 msec could have increased the chance of irradiating the laser pulses of different wavelengths at approximately the same location, thereby decreasing the risk of side effects. Nevertheless, further controlled clinical investigations in a large population should be conducted to confirm our findings.

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