Combination Treatment of Nd:YAG Picosecond-domain Laser and Fractional CO₂ Laser for Contracted Neck Scar with Hyperpigmentation

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There is growing interest in minimizing postoperative scarring after a thyroidectomy. Among the many treatment types, laser therapy, especially picosecond-domain laser therapy, is accepted as a standard method. In the present case, a patient with a pigmented, contracted scar was treated using the combination of a picosecond laser and ablative fractional (AF) CO₂ laser. After 15 sessions of 1,064-nm picosecond with micro lens array (MLA) and AF CO₂ laser application, the patient showed significant improvement in their pigmented lesions and scar contracture with no noticeable side effects for 16 months. These results suggest that a combination of picosecond laser with MLA and AF CO₂ laser can treat pigmented, contracted scars safely and effectively.

Key words

Laser therapy; Pigmented scars; Contracted scars; Picosecond laser; CO₂ laser

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INTRODUCTION

Thyroid cancer is one of the most common and rapidly increasing tumor worldwide, including Korea.¹ Considering that the majority of these patients are young women, minimizing postoperative scar gets more and more interests in both patients and clinicians. In a past decade, Many surgical methods such as endoscopic guided surgery or robotic surgery have been developed to minimize scarring.² But still, postoperative management is essential to prevent and remove postoperative scars as much as possible. Silicone gel sheeting, dermabrasion, laser, scar revision surgery can be useful treatment options for scars.

Hyperpigmentation, a reactive hypermelanosis of the skin is usually accompanied by scarring. Treatment of hyperpigmentation consists of a variety of medication and procedures. Topical agents such as retinoids, vitamin C, azelaic acid, hydroquinone, chemical peels, and laser therapy are used. Among these methods, nanosecond-domain lasers such as Q-switched ruby laser, low-dose Q-switched neodymium-doped yttrium-aluminum-garnet (Nd:YAG) laser and fractional 1,550-nm erbium-doped fiber laser have been widely used. But there are few studies about efficacy of picosecond-domain lasers in pigmented lesion.³

We introduce a case of thick contracted scar with pigmentation after robotic thyroidectomy treated by 1,064-nm picosecond Nd:YAG laser with micro lens array (MLA) and ablative fractional (AF) CO₂ laser in this case report.

The patient presented significant improvement in pigmented lesions and scar contracture with no noticeable side effects after 15 times of treatment during 16 months.

CASE REPORT

A 28 years old female patient with history of robotic thyroidectomy in 2017 due to thyroid cancer presents a prominent scar on her right anterolateral neck as a post-

operative complication. The scar was 5 cm × 2 cm sized, whitish and thick in the middle, contracted and surrounded by pigmented lesions (Fig. 1A). She was aesthetically unsatisfied and there was a great discomfort in rotating her head because of the pulling caused by the contracted scar. After the first visit to our clinic, the patient was treated with 1,064-nm picosecond domain Nd:YAG laser with MLA (PICOCARE[®]; WONTECH, Daejeon, Korea) with setting of a 3 mm spot size, 4.4 J/cm², frequency of 10 Hz in a MLA scar mode and total of approximately 2000 shots on the pigmented lesion and contracted scar. 10,600 nm AF CO₂ laser (Line-xeltm; ELESYS, Kwangmyeong, Korea) was also applied with duration range from 280-500 μs in the middle of the scar, the thickest part. Each session has 4 weeks of interval, and total 15 times of treatment was held from July 2019 to November 2020 at our outpatient clinic. From the first treatment, the pigmented lesions and scar contracture improved visually and tension with rotating her head and neck due to scar contracture was also improved (Fig. 1B). After 15 sessions, There is little pulling with head and neck motion and the patient's satisfaction with both symptom relief and aesthetic improvement was high (Fig. 1C).

DISCUSSION

Cosmetic laser can be used in various types of skin problem and there is high demand in patients and clinicians. Although, selective photothermolysis using picosecond laser is accepted as a current standard laser treatment for various types of scars, complete clearing of thickness and pigmentation of scars may not be achieved and multiple treatments are usually required to get satisfying results.⁴ The mechanism of picosecond laser improving scar is based on laser-induced optical breakdown (LIOB). Picosecond laser with MLA pulses concentrate enough power in targeted spots to generate LIOB either in the epidermis or the dermis.^{5,6}

Laser-induced optical breakdown is different from

Fig. 1. (A) Photographic finding before the treatment. (B) After 7 times of therapy. (C) Most recent finding after 14 times of therapy.

other laser-based method that it's a non-linear absorption process only can occur when the radiance is high enough to produce a critical free electron density of 10^{21} cm^{-3} . Free electrons around targeted area absorb laser light and form second free electrons. This cascade creates ionized plasma absorbing remaining laser radiation. In the last step of LIOB, plasma generation inducing explosive vaporization occurs.^{6,7} It makes cavitation bubbles in the skin. These bubbles expand and disrupt tissues around and generate shock waves that last disruption of tissue and generate repair. With this minimally invasive treatment, microscopic intradermal lesions are created but epidermis remains intact. It leads to release of contracted collagen tissue and formation of new collagen.⁷

Mechanism of AF CO₂ laser is fractional photothermolysis (FP) creating vertical columns of thermal injury called microscopic treatment zones (MTZs) using fractional emission of light at specific depths in the skin preserving tissue around these columns. These uninjured tissues surrounding each MTZ heals around these columns with thermal damage, stimulating collagen remodeling.⁸

In our case, we used picosecond Nd:YAG laser with MLA on pigmented lesion and contracted scar but we thought AF CO₂ laser is more appropriate for softening the thick middle part of the scar. So we apply both laser on each part of the scar. Immediately after first session, significant improvement of the scar was observed. With LIOB by picosecond laser, contraction of the scar was released and the pigmented lesion has changed similar to normal skin. AF CO₂ laser softened the thick part of the scar through collagen remodeling. The patient was satisfied with both cosmetic and symptomatic outcome.

With this case report, we suggest that this combination of therapy of picosecond Nd:YAG laser with MLA and AF CO₂ laser can be considered as a potential therapy for pigmented, contracted scar.

CONFLICT OF INTEREST

Eun Soo Park is an editorial board member of the journal but was not involved in the review process of this manuscript. Otherwise, there is no conflict of interest to declare.

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