Case Report

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Hair Loss Treatment Using Erbium:YAG Fractional Laser with Hair Growth-promoting Solution

Dong Hyun Ahn

Daeyoung Plastic Surgery Clinic, Seoul, Korea

Several methods have been used to treat androgenetic hair loss, ranging from hair transplants to finasteride and minoxidil. Sometimes platelet-rich plasma injection therapy may be used to increase the satisfaction of patients who come to the hospital. However, some patients are sensitive to pain and are subjected to the inconvenience of requiring treatment after each blood sampling. The author had reported the effects of using a hair growth-promoting solution and Jetpeel™ in parallel with a painless hair loss treatment method. However, the author was interested in more effective methods for patients with M-shaped or vertex hair loss who do not want to take medications or undergo hair transplant. In addition to the existing light-emitting diode therapy and electromagnetic field treatment, the author has made considered attempts to use various laser wavelength bands. However, the equipment for these methods can be expensive and are not suitable for patients who emphasize on cost-effectiveness. Therefore, the author used an existing reported method and a device based on the fractional erbium:YAG laser to provide the hair growth-promoting solution in parallel. The author chose a fractional 2940 nm-based laser device as a medium that could efficiently increase the growth phase, reduce the catagen phase, and facilitate intradermal product and drug delivery. As a result, there was a therapeutic benefit without any significant side effects such as redness and itching. Among the patients, the author reported the effects of the treatment on one patient with frontal M-shaped, mid, and vertex hair loss.

Key words
Hair loss; Solution; Er:YAG laser

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Correspondence
Dong Hyun Ahn
Daeyoung Plastic Surgery Clinic,
338 Apgujeong-ro, Gangnam-gu,
Seoul 06018, Korea
Tel.: +82-2-3446-7788
Fax: +82-2-3442-6606
E-mail: cyyaks@naver.com

INTRODUCTION

The ablative fractional 2940-nm erbium:YAG laser was first introduced for hair restoration in 1995 and has recently been implicated for hair regrowth in the murine model.[1] The results of a controlled trial by Ke et al. with C57/BL/6 mice indicated that the anagen phase started significantly earlier in mice treated with this laser than in the control mice, and the period between the anagen and catagen phase was significantly shorter in the laser group.[1,2] The erbium:YAG laser also increased hair growth by regulating the β-catenin and Wnt 10b pathways, promoting hair cycle transition from the telogen to the anagen phase.[1,2] Laser treatment combined with minoxidil further increased hair growth.[1,2] These results suggest that 2,940-nm erbium:YAG laser treatment may be a potential therapy for hair loss.[1] Later, reports were made on various clinical experiences with several lasers.[2,3] Furthermore, using lasers can be an effective drug permeation-enhancement approach for facilitating drug delivery into or across the skin.[1] The controlled disruption and ablation of the stratum corneum, the predominant barrier to drug delivery, is achieved by the use of lasers.[4] The possible mechanisms of laser-assisted drug permeation are the direct ablation of the skin barrier, optical breakdown by a photomechanical wave, and a photothermal effect.[4] Er:YAG fractional laser ablation reversibly impairs stratum corneum barrier function, creating an interface for molecular transfer from the formulation to the skin, followed by lateral and vertical diffusion.[5] Therefore, the author considered several studies on drug delivery based on the effect of the Er:YAG fractional laser.[4-8] Furthermore, it has been reported that living human cells are transmitted into the skin.[6] Based on existing reports,[9] the author focused on patients with M-shaped or vertex hair loss (male pattern hair loss grade Hamilton-Norwood I-IV) and fractional 2940-nm erbium:YAG lasers. The laser and hair growth-promoting solution was applied at the same time. Among the patients, the author reports the effects of the 48-year-old male patient with frontal M-shaped, mid, and vertex hair loss.

CASE REPORT

A 48-year-old male patient with frontal M-shaped, mid, and vertex hair loss had a family history of hair loss but had no problems in other history or physical findings. He had no history of treatment with topical or oral medications, including minoxidil, finasteride, dutasteride, and mesotherapy (including micro-needle treatment) or intra-perifollicular injection therapy; laser/light-based therapy, including fractionated laser treatment and low-level light therapy; intra-perifollicular platelet-rich plasma preparation injection, or hair transplantation in the previous six months. The diagnosis of hair loss was made by physical examination. An SM-N986N camera (Samsung Electronics Co. Ltd., Gyeonggi-do, Korea) and the APM-AH-300 diagnostic system (phototrichogram) (Aram Huvis Co. Ltd., Gyeonggi-do, Korea) were used to evaluate the clinical features of the hair loss type, scalp condition, hair density, scalp keratin, scalp blood vessel exposure, pore condition, hair thickness, and the hair shaft cuticle.

Digital images of the scalp and hair were captured at 60-fold magnification using an APM-AH-300 diagnostic system (phototrichogram) to objectively evaluate the images at baseline and one week after the final treatment. The lens of the camera was positioned at the point along the vertex of the scalp where the mid-sagittal and coronal planes intersected and the center of the frontal M-shaped area. Next, relative values for hair counts and thickness were measured. The patient had no side effects associated with treatment, including scalp redness, edema, crusting, infection, itching, allergic reactions, or the progression of hair loss, etc. The patient demonstrated considerable improvement in both hair count and hair thickness one week after the final treatment session compared to the baseline values. The treatment session took ≤ 20 min.

Before each treatment, we cleaned the scalp with normal saline. Local anesthesia was not used in the procedures because the patient reported no pain during the treatment. The patient was advised to refrain from using other hair loss products during the treatment and follow-up periods. After obtaining written informed consent, we treated the frontal, mid, and vertex areas of the scalp with ablative fractional Er:YAG 2940-nm PURAXEL® (LA-MEDITECH, Seoul, Korea) Step 1 (approx. 0.05 J/cm^2) for one week. Each treatment was conducted once without superposition.

The purpose of this treatment was to deliver thermal stimulation to the scalp and at the same time, create about 100 multi-micro holes of 0.2 mm or less once in the epidermal layer to facilitate drug absorption. The photo below shows the results of measuring the depth of the energy step of PURAXEL® with the OCT Model: Thorlab VEG210C1 (Fig. 1A-C), a photo of the irradiated surface of the skin (Fig. 1D), and the investigated dots (Fig. 1E). At the end of the treatment, there was no burning and no pain, with or without a little treatment site erythema. Immediately after the laser surgery, a Mr. Care Hair Vital Am-

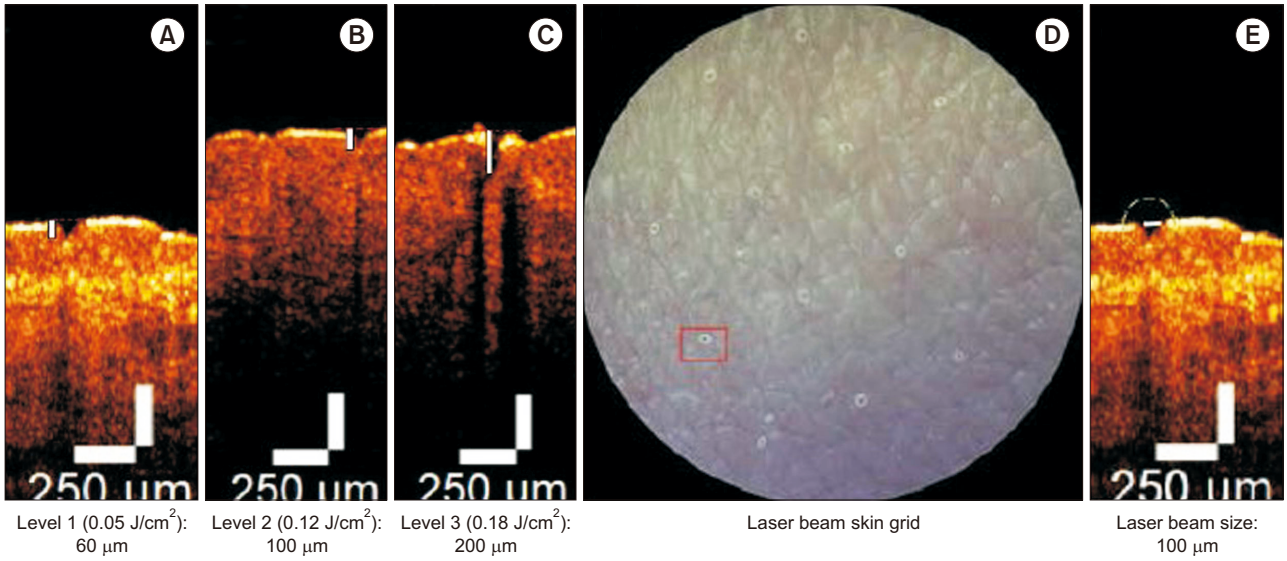

Fig. 1. The photo shows the results of measuring the depth of the energy step of PURAXEL® with the OCT Model: Thorlab VEG210C1 (A-C), photo of the irradiated surface of the skin (D), and the investigated dots (E).

poule plus (6 ml mixture of human adipose stromal cell-conditioned media, panthenol, niacinamide, biotin, and zinc sulfate; Mr. Care Co., Seoul, Korea) was sprayed on the entire scalp, including the frontal region and parietal region using the JetPeel™ system (microdroplets, 5-20 microns; pressure, 90 PSI; velocity; 200 m/s; TavTech Ltd., Yehud, Israel). This hair growth-promoting agent was registered previously as a hair care product (cosmetics) in Korea and was also registered with the Food and Drug Administration (FDA_ (Voluntary Cosmetic Registration Program [VCRP]) in the United States. The Mr. Care Hair Vital Ampoule Plus was sprayed on the affected areas of the scalp once a week for three months via the JetPeel™ system after ablative fractional Er:YAG 2940-nm (PURAXEL®) treatment. Figs. 2 and 3 present changes in hair growth as measured by clinical photography and phototrichogram images of the scalp of the 48-year-old male patient with frontal, mid, and vertex hair loss who received 6 ml (1 ampule) of Mr. Care Hair Vital Ampoule Plus weekly for three months using the JetPeel™ system after ablative fractional Er:YAG 2940-nm (PURAXEL®) treatment. Interestingly, it was difficult to observe these results in patients with frontal M-shaped hair loss in the previous treatment, which did not treat with laser. As the number of treatments was increased, he said that he could feel the rough texture on the frontal M-shaped hair loss area more than before so he thought that hair thickness was thicker than before.

The relative values for hair count and thickness were measured with the ANALYZE and MEASURE plug-ins

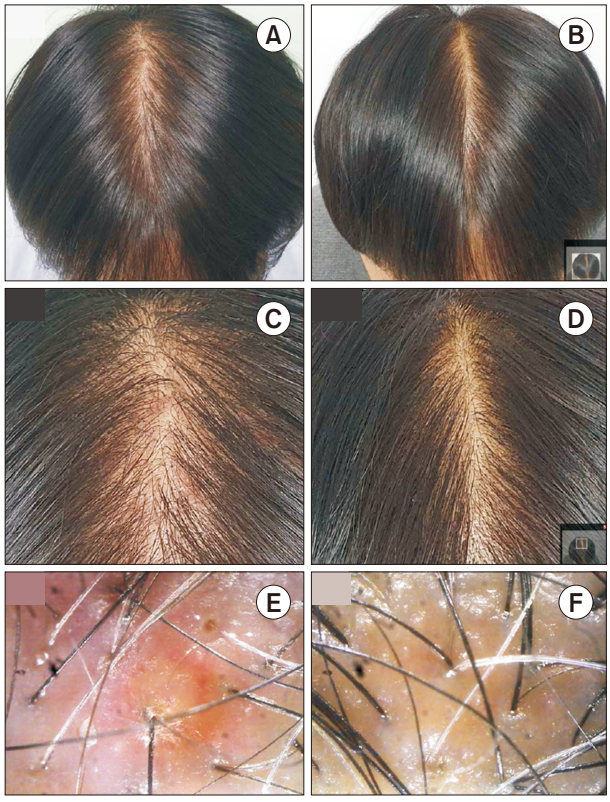

Fig. 2. Picture (A) was taken before treatment and (B) was taken one week after three months of treatment (original magnification ×1 (above). Pictures (C, D) are close-up views of (A, B) (below). Pictures (E, F) were taken with a hair analyzer, APM-AH-300 diagnostic system (phototrichogram) at the vertex of the scalp where the mid-sagittal and coronal planes intersected. Picture (E) was taken before treatment and F was taken one week after the last treatment (original magnification ×60).

in ImageJ software, version 1.53e (National Institutes of Health, Bethesda, MD, USA) (Fig. 4).

In the frontal M-shaped hair loss site, the number of hairs after treatment increased by about 11.5% and hair thickness increased by 51.5% compared to before treatment. At the hair loss site on the crown, the number of hairs after treatment increased by about 31.0% and the thickness of hair increased by 28.6% compared to before treatment.

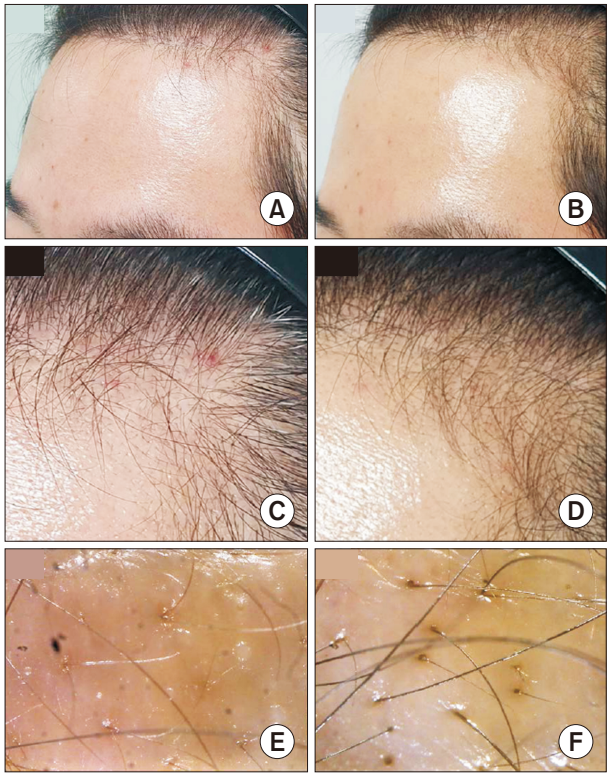

Fig. 3. Picture (A) was taken before treatment and (B) was taken one week after three months of treatment (original magnification ×1 (above). Pictures (C, D) are close-up views of (A, B) (below). Pictures (E, F) were taken with a hair analyzer, APM-AH-300 diagnostic system (phototrichogram) at the center of the frontal M-shaped area. Picture (E) was taken before treatment and F was taken one week after the last treatment (original magnification ×60).

DISCUSSION

Hair loss is one of the most common chronic diseases in the world. Hair loss treatments have been performed using various lasers and have already been reported.[1] Among them, the ablative fractional Er:YAG 2940-nm laser was experimentally found to upregulate Wnt/Beta-Catenin expression.[2] Also, ablative fractional Er:YAG 2940-nm laser revealed that if the laser is set appropriately, it will create conditions that allow it to penetrate well into the scalp.[1] Many studies on laser penetration methods and results have been reported.[4-8] The drug delivery method opens the stratum corneum and allows the drug to enter the intercellular, transcellular, and transappendageal pathways. At this time, when the laser acts, direct ablation, optical breakdown by photomechanical waves, and a photothermal effect are generated, so that the drug can be transferred efficiently.[4] The fractional Er:YAG 2940-nm laser allows mediators to pass painlessly with minimal damage to surrounding tissue compared to other lasers. It works by creating fine holes through the epidermis and producing heat while absorbing water. Additionally, recent technological developments have made it possible to adjust the size and depth of the holes in the epidermis to allow substances with high molecular weight and bioactive agents to pass through. Therefore, it can be the most universally comfortable and safe laser.[10] Hair follicle stem cells provide progeny that migrates to the epidermal defect and promotes re-epithelialization.[1]

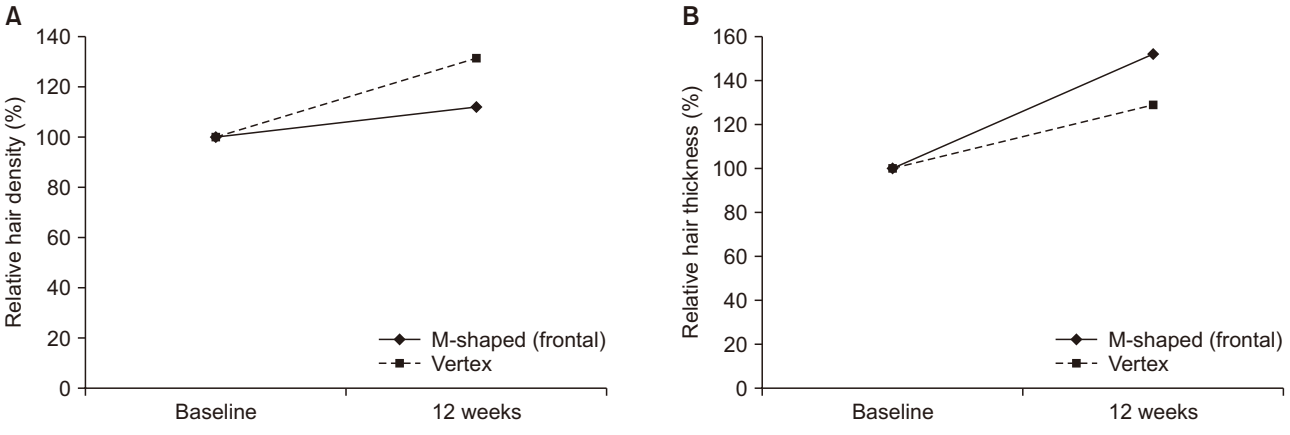

Fig. 4. The number (A) and mean thicknesses (B) of the hairs.

The addition of Wnt signaling in dermal papilla cells plays an important role in stimulating hair growth. And the already-known mesenchymal stem cell-derived signaling and growth factors have been reported to affect hair growth.[11] The adipose stem cell culture medium, which also contains the hair growth-promoting solution used by the author, accelerates cell cycle progression when the dermal papillar cells proliferate and migrate, and at the same time, increases Wnt/β-catenin pathway protein levels.[12] This was judged to have a positive effect during parallel treatment with the laser. The above-mentioned material, when applied with minoxidil and ablative fractional Er:YAG 2940-nm laser, can accelerate the transition from telogen to anagen and ultimately affect the hair growth cycle.[2] The author has already reported the treatment results using a hair growth-promoting solution in 2019.[9] Thus, a synergistic effect was confirmed by treating the hair growth-promoting solution used in the author's previous paper in parallel with the ablative fractional Er:YAG 2940-nm laser. However, more patient studies and long-term observations are needed. And the author hopes to present a comparative result about the Er:YAG laser effect (hair growth-promoting solution only group vs Er:YAG laser with hair growth-promoting solution combined group) in the future.

CONFLICT OF INTEREST

No potential conflict of interest relevant to this article was reported.

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None.

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