Clinical effects of non-ablative and ablative fractional lasers on various hair disorders: a case series of 17 patients

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Abstract

Background and objectives: Both ablative and non-ablative fractional lasers have been applied to various uncommon hair disorders. The purpose of this study was to demonstrate the clinical effects of fractional laser therapy on the course of primary follicular and perifollicular pathologies and subsequent hair regrowth. Materials and methods: A retrospective review of 17 patients with uncommon hair disorders – including ophiasis, autosomal recessive woolly hair/hypotrichosis, various secondary cicatricial alopecias, pubic hypotrichosis, frontal fibrosing alopecia, and perifolliculitis abscedens et suffodiens – was conducted. All patients had been treated with non-ablative and/or ablative fractional laser therapies. Results: The mean clinical improvement score in these 17 patients was 2.2, while the mean patient satisfaction score was 2.5. Of the 17 subjects, 12 (70.6%) demonstrated a clinical response to non-ablative and/or ablative fractional laser treatments, including individuals with ophiasis, autosomal recessive woolly hair/hypotrichosis, secondary cicatricial alopecia (scleroderma and pressure-induced alopecia), frontal fibrosing alopecia, and perifolliculitis abscedens et suffodiens. Conversely, patients with long-standing ophiasis, surgical scar-induced secondary cicatricial alopecia, and pubic hypotrichosis did not respond to fractional laser therapy. Conclusion: Our findings demonstrate that the use of non-ablative and/or ablative fractional lasers promoted hair growth in certain cases of uncommon hair disorders without any remarkable side effects.

Key Words: abscedens et suffodiens, carbon dioxide, congenital hypotrichosis, erbium–glass, fractional laser, ophiasis, perifolliculitis, scar, scleroderma

Introduction

Fractional lasers, especially non-ablative 1,550-nm erbium–glass fractional lasers (NAFLs) and ablative 10,600-nm carbon dioxide fractional lasers (AFLs), have been proven effective in treating various dermatologic diseases, including atrophic scars, enlarged pores, striae distensae, and photoaging (1–5). Moreover, NAFL has also been shown to be effective in the treatment of alopecia areata, male pattern hair loss, and female pattern hair loss (6–8), with several murine studies suggesting that low-fluence and high-density NAFL irradiation affects the hair cycle by promoting telogen to anagen transitions (8). Accordingly, it has now been suggested that laser therapy-associated hair regrowth may result from Wnt 5a and β-catenin expression (8).

Based on the previous reports (6–8), the therapeutic effect of both NAFL and AFL was assessed in the treatment of various uncommon hair disorders, including ophiasis, autosomal recessive woolly hair/hypotrichosis, various secondary cicatricial alopecias, pubic hypotrichosis, frontal fibrosing alopecia, and perifolliculitis abscedens et suffodiens. The purpose of this study was to demonstrate the clinical efficacy of fractional laser therapy on the disease course of both primary follicular and perifollicular pathologies as well as subsequent hair regrowth via a retrospective review of 17 patients with uncommon hair disorders.

Materials and methods

A total of 17 patients (9 men and 8 women with a mean age of 33.1 ranging from 18 to 67) previously treated with NAFL and/or AFL therapies for scarring or non-scarring hair disorders were retrospectively...
<table>
<thead>
<tr>
<th>Patient No.</th>
<th>Sex/age (years)</th>
<th>Clinical diagnosis</th>
<th>Disease duration/previous treatment modalities</th>
<th>Type of fractional laser/treatment interval</th>
<th>No. of fractional laser treatments</th>
<th>Concomitant treatments for hair disorders</th>
<th>Minimum number of sessions before noticeable improvement</th>
<th>Improvement grade</th>
<th>Patients’ degree of satisfaction</th>
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<td>Non-ablative/ablative/2 weeks</td>
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<td>Since childhood/none</td>
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<td>Oral finasteride</td>
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<td>Non-ablative/ablative/4 weeks</td>
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<td>Non-ablative/ablative/4 weeks</td>
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<td>Ablative/2 weeks</td>
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<td>Ablative/3 weeks</td>
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<td>Non-ablative/ablative/3 weeks</td>
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<td>Non-ablative/ablative/2 weeks</td>
<td>15</td>
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<td>M/18</td>
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<td>3 years/systemic antibiotics, systemic isotretinoin, intrallesional injection of triamcinolone acetonide, incision and drainage</td>
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<td>17</td>
<td>Systemic isotretinoin</td>
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reviewed for this study. These individuals carried a variety of clinical diagnoses, including ophiasis (n = 3), autosomal recessive woolly hair/hypotrichosis (n = 3), secondary cicatricial alopecias (pressure-induced alopecia, n = 3; scleroderma, n = 2; surgical scar, n = 2), pubic hypotrichosis (n = 2), frontal fibrosing alopecia (n = 1), and perifolliculitis abscedens et suffodiens (n = 1). Table I summarizes the specific subject demographics.

All enrolled subjects were treated with between 8 and 22 sessions (mean, 15.2) of NAFL using a 1,550-nm erbium–glass Mosaic™ laser (Lutronic Corporation, Goyang, Korea) and/or AFL therapies using a 10,600-nm Mosaic eCO2™ laser (Lutronic Corporation). During all NAFL treatment sessions, two passes were performed in static operating mode without local anesthesia at a fluence of 6–8 mJ and a density of 300 spots/cm²/pass. For all AFL treatment sessions, a laser fluence of 30 to 50 mJ was delivered to the affected areas in static operating mode without local anesthesia using a density of 150 spots/cm² (spot diameter of 120 μm; percent coverage of 8.1%–10.2%). Per the manufacturer’s instructions, the estimated maximal ablation depth of the AFL treatments was 600 μm using the following settings: 30 mJ and 762 μm with 50 mJ. An epidermal cooling device (Zimmer Medizin Systems, Irvine, CA) was used during AFL treatments for pain relief. In one subject with perifolliculitis abscedens et suffodiens, AFL treatments were delivered to suppurative lesions in static operating mode after local anesthesia with 1% lidocaine with a fluence of 80 to 120 mJ and a density of 150 spots/cm² (spot diameter of 120 μm; percent coverage of 12.5% to 15.1%; expected maximal ablation depth of 1168 to 1850 μm). Immediately after all NAFL and/or AFL treatments, the treated areas were cooled with icepacks. For patients treated with AFL, an antibiotic ointment containing mupirocin was also applied to all the affected areas.

In all cases, photographs were obtained at baseline and at two months after the final treatment session. Objective clinical assessments were performed by two blinded dermatologists who compared the before and after photographs in non-chronological order using a global improvement score scale (grade 0: worse; grade 1: 0–25% = no change or minimal improvement; grade 2: 26%–50% = moderate improvement; grade 3: 51%–75% = marked improvement; and grade 4: more than 75% = near total improvement). Patients were also surveyed two months after the final treatment to assess their overall satisfaction with the treatment results using the following scale: very satisfied (grade 4), satisfied (grade 3), slightly satisfied (grade 2), and unsatisfied (grade 1).

At every subject visit, all possible side effects were assessed and recorded, including bleeding, oozing, post-treatment dyschromia, scaling, crusting, erythema, and progressive hair loss. Then, two months after the final treatment, all reported side effects related to the treatment were reassessed and analyzed. Of note, this retrospective study was approved by the Institutional Review Board of Severance Hospital, Yonsei University College of Medicine, Seoul, Korea.

Results

Of the subjects included in the study, 7 were treated with NAFL alone, 6 with NAFL and AFL combination therapy, and 4 with AFL alone. The mean clinical improvement score of the 17 patients was 2.2, while the mean patient satisfaction score was 2.5 (Table I). Of these 17 patients with hair disorders, 12 patients (70.6%) demonstrated clinical response with NAFL and/or AFL treatments (responder group), while 5 (29.4%) did not improve or worsen after laser treatment (non-responder group).

In the responder group, the minimal number of sessions that showed any noticeable improvement was 4.8 ± 2.3. The mean score of clinical improvement in the responder group was 2.8, with a patient satisfaction score of 3.1. Specifically, patients with a long history of ophiasis (cases 1 and 3: 1 year and 3 months, respectively) demonstrated particularly high

Figure 1. A 39-year-old Korean male with ophiasis (case 3). (a) Prior to treatment. (b) Two weeks after five treatments with non-ablative 1,550-nm erbium–glass fractional laser treatment. (c) Two months after the final of 13 treatment sessions.
improvement grades and satisfaction rates (Figure 1). Although all of the three patients with autosomal recessive woolly hair/hypotrichosis (cases 4–6) were concomitantly treated with oral finasteride, clinical improvements in hair thickness and length were observed both at the vertex and at the temporal and posterior scalps (Figure 2).

In patients with scleroderma-induced secondary cicatricial alopecia (cases 10 and 11), improvement of depressed sclerotic scars on the frontal scalp was observed after the first AFL treatment session. Furthermore, terminal hair regrowth was also noted on the depressed alopecic patches in two patients treated with AFL (Figure 3). Another patient with frontal fibrosing alopecia (case 16) showed marked improvement in the sclerotic texture of the alopecic patches as well as in the partial hair re-growth and thickening after repetitive AFL treatments, but did not respond to NAFL treatment (Figure 4). After AFL treatment, the individual hair shafts that had previously been trapped in dermal collagen bundles were able to grow out of the scalp.

One patient with biopsy-proven perifolliculitis abscedens et suffodiens previously treated with systemic antibiotics, systemic isotretinoin, intraloesional triamcinolone acetonide injections, and repeated incision and drainage presented with painful, fluctuant alopecic nodules. After obtaining informed consent, the patient underwent AFL treatments at three-week intervals and was concomitantly treated with systemic isotretinoin at a dose of 20 mg/day. Immediately after each treatment session, pus if any was drained through the AFL-induced necrotic columns (Figure 5). Following the third AFL treatment session, the lesions were noted to have decreased in both severity and number, and hair regrowth was observed.

The non-responder group included one of the three patients with ophiasis (case 2), who had an 8-year history of the disease, both patients with surgical scar-induced secondary cicatricial alopecia (cases 12 and 13) and both patients with pubic hypotrichosis (cases 14 and 15). Although further progressive hair loss was not observed in the non-responder group, no noticeable hair regrowth was achieved after repeat treatments with both NAFL and AFL.

In this study, side effects of treatment included pain during the laser treatment (especially during AFL), and transient post-treatment crusting, scaling, erythema, and edema. Other possible side effects, such as secondary bacterial or viral infection, post-therapy blister formation, hypopigmentation, and scarring, were not observed.

**Discussion**

Ophiasis is a special pattern of alopecia areata with coalescing alopecic patches characteristically involving the occipital scalp, bilateral temples and, rarely,
the frontal hairline (9). This type of alopecia areata classically has a relatively poor prognosis and often remains refractory to most treatment modalities (9,10). In the present study, we observed that ophiasis patients who had experienced a disease duration of one year or less demonstrated marked improvement with NAFL treatments. In contrast, the one patient with an 8-year history of ophiasis did not respond to treatment with either AFL or NAFL. Therefore, we suggest that repetitive NAFL treatment may have some therapeutic efficacy on early ophiasis lesions.

Secondary cicatricial alopecias refer to conditions where the incidental destruction of hair follicles results from primary events occurring outside the follicular unit (11). Such primary events can include scalp conditions such as genodermatoses, developmental defects with associated permanent alopecias, physical and chemical injuries, inflammatory dermatoses, drug use, and neoplasms (12). Although various therapeutic modalities have been used to treat primary scalp conditions in secondary cicatricial alopecias, additional surgical scar revision and hair transplantation are often needed to correct permanent alopecia.

To date, various treatment modalities – including high-potency topical corticosteroids, topical calcipotriol, imiquimod, and low-dose ultraviolet A phototherapy – have been used to treat early-stage localized scleroderma (13–15). However, as with secondary cicatricial alopecias, surgical scar revision and soft tissue augmentation are often needed to correct permanent atrophic scars and dyschromias (16). In the present study, we used AFL to treat sclerotic lesions on the scalp that had resulted from various primary pathologies. After several AFL treatment sessions, these lesions improved both in texture and in overall degree of induration, with terminal hair regrowth additionally observed. However, the mechanism of hair recovery as a result of this treatment remains to be elucidated.

Previously, our study group demonstrated that a patient with hidradenitis suppurativa affecting both axillae demonstrated clinical improvement in both the number and severity of suppurative lesions after treatment with repetitive AFL (17). Here, our results...
demonstrate that AFL treatment not only reduced the severity and number of lesions in a patient with perifolliculitis abscedens et suffodiens, but also elicited hair regrowth. The clinical course of such suppurative diseases – including hidradenitis suppurativa and perifolliculitis abscedens et suffodiens – tends to be chronic and recurrent (18). The affected follicular epithelium, follicular plugging, and thick and intricate scar tissue are all major pathogenetic factors in perifolliculitis abscedens et suffodiens, and respond to AFL via the use of fractional technology (17,19).

We attribute the therapeutic effects of AFL and NAFL to physical breakage and thermal stimulation of the lesions, which may serve to induce regeneration and realignment of the thick collagen bundles in the scar tissue responsible for the resulting alopecic patches. As AFL has been shown to induce immediate tissue tightening (vs. NAFL), reduction in the width of the atrophic patches may also have contributed to the clinical improvement observed (20). In a previous study, Ito et al. (21) demonstrated Wnt-dependent de novo hair follicle neogenesis in adult mouse skin after wounding, specifically showing that a wound stimulus is sufficient to trigger the regeneration of hair follicles from epithelial cells by inducing an embryonic phenotype in the skin (21). The wounds resulting from fractional laser therapy may have contributed to hair follicle neogenesis.

In conclusion, our findings demonstrate that the use of AFL and/or NAFL promoted hair growth in certain cases of uncommon hair disorders without any remarkable side effects. Although the data presented here indicate that AFL and NAFL treatment did not worsen various hair disorders, patients with a long history of ophiasis, surgical scar-induced secondary cicatricial alopecia, or pubic hypotrichosis did not respond to AFL and/or NAFL therapies. However, optimized and prospective studies are needed to confirm the efficacy and safety of AFL and/or NAFL treatments demonstrated by our findings.

Declaration of interest: The authors report no declarations of interest. The authors alone are responsible for the content and writing of the paper.

References