

Clinical efficacy of 1550nm fractional erbium-glass laser in the treatment of alopecia areata patients

LIU Hui-feng¹, XIAO Han-long², AN Xiang-jie³, LIU Shi-wen¹,

CHEN Yan¹, LI Gang¹, CHEN Fu-ting¹, TU Ya-ting³

Abstract: To observe the clinical efficacy and safety of 1550nm fractional erbium-glass laser in the treatment of alopecia areata(AA)patients. Thirty-six patients with AA were treated with 1550nm fractional erbium-glass laser every two weeks for a maximum of three sessions. The overall rate of positive treatment response were observed in patients after the second, fourth, sixth week. Severity grading of AA was carried out using the Severity of Alopecia Tool (SALT)score before and after treatment. A significantly difference in positive response was observed between the third and first or between the third and second sessions($P < 0.001$). A significant improvement of SALT score was observed after the treatment. Efficiency rate was 88. 9%. 1550nm fractional erbium-glass laser is an effective treatment option for AA, with minimal reversible side effects.

Key words: 1550nm fractional erbium-glass laser; Alopecia areata

Alopecia areata (AA) is a common disease in dermatology. The incidence rate of AA is 0. 7% to 3. 8%. AA is characterized by localized patchy alopecia with clear boundary, which suddenly occurs. Besides hair, it can also affect armpit hair, pubic hair and eyebrows. Some patients can lose all their hair overnight. Especially when it involves children and adolescents, AA often leads to significant mental disorders. In acute stage of AA scalp biopsy, lymphocytes and eosinophils around hair follicles infiltrated, and IFN- γ ^[1], IL-1 α and β ^[2], TNF- α , MHC and Fas- antigen and macrophage migration inhibitory factor ^[3] and other cytokines participated in the periodic growth of hair, which played an important role in the pathogenesis of AA.

The treatment of AA includes local injection of corticosteroids into skin lesions, local use

of DPCP and PUVA, and systemic use of corticosteroids or immunosuppressants. However, some of these treatments have poor tolerance and some side effects, which limit their application.

In recent years, lasers and various light sources have been widely used in medical field. Low level light energy can play a role in photobiological regulation on cells, and it can be used to treat male and female alopecia. This study investigated the clinical efficacy and safety of 1550nm fractional laser in the treatment of alopecia areata.

1 Medical Records

1.1 Object of Study

36 patients with alopecia areata were from outpatient treatment of Wuhan Institute of Dermatology Prevention and Treatment from 2012 to 2014. Among them, there were 17 males and 19 females, aged from 19 to 60 years, with an average age of (32.5 \pm 12.4)years. The course of disease ranged from October to 60 months, with an average of (40.5 \pm 25.3)months.

1.2 Diagnostic Criteria

According to the diagnostic criteria of alopecia areata in Chinese Clinical

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Author brief introduction: Liu Hui Feng (1971-), male, deputy chief physician, medical doctor, e-mail: lhflwyyy@126.com.

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Dermatology^[4] edited by Zhao Bian, the hair suddenly falls off without feeling, which is one or several well-defined round or oval alopecia areas with a diameter of about 1cm to 2cm or larger. If it is in the advanced stage, the hair in the alopecia area is loose and easy to pull out; During the recovery period, the hair at the damaged edge is firm.

1.3 Inclusion Criteria

(1) The patient has received alopecia areata treatment before, but the curative effect is not good. He has not used glucocorticoid, immunomodulator or other systemic treatment drugs in recent 1 month, and has not received local treatment in recent 1 month; (2) Blood routine, liver and kidney function are normal, and there is no systemic disease; (3) Age 18 to 65 years old; (4) Sign the informed consent form.

1.4 Exclusion Criteria

(1) Pregnant or lactating women under the age of 18 or over 65; (2) Complicated with serious primary diseases such as cardiovascular, cerebrovascular, liver, kidney and hematopoietic system, psychotic patients, hair loss caused by other diseases, drugs and physical and chemical factors; (3) Congenital alopecia; (4) Acquired alopecia: endocrine dysfunction diseases, severe acute infectious diseases, chronic diseases, syphilis, leprosy and other skin diseases that can cause alopecia, as well as those caused by drugs and trauma; (5) Scary baldness.

2 Method

2.1 Therapeutic Method

1550nm non-ablative fractional laser (Shenzhen GSD Company) was used, the pulse energy was 7mj/cm², and the treatment was once every two weeks. Each patient received 3 treatments, and the pulse energy per unit area used by each patient was the same. In the treatment process, there is no need for local anesthetics, and laser treatment

cannot damage hair itself. After treatment, slight erythema can be seen in the treatment area.

2.2 Disease Assessment

SALT (severity of alopecia tool, salt)^[5] was used to evaluate the alopecia area of alopecia areata patients before and after treatment.

2.3 Observation and Judgment Standard of Curative Effect

High resolution Nikon cameras (Nikon P-300, Tokyo, Japan) were used to take pictures before and after treatment, and the effectiveness of treatment was evaluated by two independent dermatologists according to the photos taken before and after treatment and the clinical reaction of patients. The evaluation contents include whether there is hair regeneration, itching or erythema, colorless sinking or discoloration, and other side effects. SAIT score was performed before and after 3 months of treatment for each patient. After treatment, there were new cases with positive reaction, otherwise it was negative reaction. 2, 4, 6 weeks after treatment, observe whether there is new growth.

Cure: =100%, all new hair grows, distribution density and color are normal; Significant effect: 50% ≤ n < 100%, new hair growth above 50%, density, thickness and color are close to normal; Effective: 1% ≤ n < 50%, new hair grows below 50%, there are shaggy hair and white hair, and hair stops falling off; Invalid: n < 1%, no new growth, or continuous shedding. The curative effect was determined after 3 months of treatment. The total effective rate is based on the obvious effect of yoga.

2.4 Statistical Analysis

Accurate analysis of X² and Fisher's was used to test the positive reaction before and after treatment. We compared the SALT scores before and after treatment by paired t test.

With SPSS10.0 analysis package, P < 0.05 was considered to have significant significance.

3 Results

The therapeutic effect is shown in Figure 1. See table 1 for the classification of AA patients. After the first laser treatment, the positive reaction was 60%, 75% after the second treatment and 100% after the third treatment. Compared with the first treatment, the positive reaction after the third treatment is significantly different ($P < 0.001$), and the third treatment is also significantly different from the second treatment ($P < 0.001$), as shown in Table 2. Compared with before treatment, the SALT score after treatment was significantly improved, and the difference was significant ($P < 0.001$). See Table 3. After 3 months of treatment, the cure rate was 69.4% and the effective rate was 88.9%, as shown in Table 4. After laser treatment, there was slight erythema, which could subside after 1 to 2 days. During the treatment, there were no side effects such as itching and scalp atrophy.

Table 1 Classification of AA patients

Disease grading	Number of patients
s1	23
s2	8
s3	3

Table 2 Comparison of positive reactions after 1550nm non-ablative fractional laser treatment of AA for different times

	The first treatment		The second treatment		The third treatment	
	Number of cases	%	Number of cases	%	Number of cases	%
Positive reaction	21	(60)	27 (75)	75	36*	100
Negative reaction	15	(40)	9 (25)	25	0**	0

* $P < 0.01$ vs the first treatment, ** $P < 0.01$ vs the second treatment

Table 3 Comparison of SALT scores before and after AA treatment at 1550nm

	Before treatment	After treatment
SALT score	26±3.5	4.5±2.1*

* $P < 0.001$ vs before treatment

Table 4 Evaluation of curative effect after AA treatment

Number of cases	Heal	Significant effect	Active	Invalid	Active chlorine
36	25	7	4	0	88.9%

4 Discussion

The relationship between skin injury and hair growth has always been an interesting research field. After skin injury, it can stimulate hair follicle growth or accelerate hair growth [6-8]. Ito et al. proved that normal adult mice had new hair follicles after trauma. The regenerated hair follicles establish stem cells, express molecular markers of hair follicle differentiation, produce hair shafts and further evolve all stages of hair follicle cycle, in which Wnt gene plays an important role [6]. Semenova et al. reported that the experiment in mice showed that the overexpression: mIGF-1 in keratinocytes can improve wound healing and accelerate hair follicle formation [9].

Low energy light therapy has been approved by FDA for the treatment of alopecia [10]. Avram et al. reported that patients with sparse hair increased the number of terminal hairs and the diameter of hair shaft after low-energy light treatment [11].

Light therapy is more used to treat hair loss. In recent years, it has been reported that 1550nm non-ablative fractional laser has achieved satisfactory results in the treatment of female alopecia [12]. Therefore, we infer that 1550nm non-ablative fractional laser may stimulate hair growth.

Fractional photothermal theory has been introduced into laser therapy in recent years. It can generate many small thermal damage zones with controllable width, depth and density, which are surrounded by the remaining epidermis and dermis, and can quickly repair the thermal damage caused by laser [13, 14]. 1550nm non-ablative fractional laser makes the depth of laser focal point in skin adjustable by patented precision optical device, and the spot diameter at laser focal point can be as small as 10um, which is approximately non-invasive. It breaks through the traditional pigment selective absorption

and adopts hydrothermal absorption, so that the skin can recover quickly after treatment. In this experiment, we found that 1550nm fractional laser is effective and effective in treating alopecia areata.

The possible mechanism of 1550nm non-ablative fractional laser in the treatment of alopecia areata is: (1) Fractional laser causes increased blood flow, (2) Direct stimulation of dermal papilla, (3) Many molecules in wound healing, including FGF family, EGF, IGFs, HGF, TGF- β , VEGF, nerve growth factor and interleukin, are also called key factors of hair growth and hair cycle [15, 16]. (4) In the process of hair growth and hair circulation stimulated by fractional laser, the changes of cytokines and growth factors may play an important role, especially Wnt- β -Catenin-Lef1 signal.

In the treatment experiment of alopecia areata by Sharquie KE [17], 13% of patients in the control group were observed to have hair growth with tap water, which can be considered to be related to the existence of certain self-healing factors in alopecia areata. The patients in this experiment have received other treatments for alopecia areata before, but the curative effect is not good, so it can be considered that the effect of alopecia areata self-healing in this experiment is negligible. In this trial, there were no scalp atrophy, folliculitis, systemic side effects and treatment interruption in all patients. Compared with glucocorticoid injection for alopecia areata, which has pain after injection, scalp atrophy and possible systemic side effects, 1550nm non-ablative fractional laser has better tolerance, and it may be an attractive method for alopecia areata treatment. Especially for patients who have not responded to previous treatment or have contraindications to systematic treatment, it is an appropriate alternative treatment. Compared with other laser treatments, fractional laser system has

many advantages, including controllable penetration depth and wound size, small and invisible wound, no bleeding and less damage to hair.

1550nm non-ablative fractional laser may be an effective and safe choice for the treatment of alopecia areata, but its mechanism, efficacy and long-term adverse reactions still need to be further explored.

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