Treatment of Alopecia Areata with Fractional Photothermolysis Laser

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Many studies have documented an abnormal cell-mediated immune reaction in alopecia areata (AA). The key histopathologic feature of AA is a lymphocytic infiltrate around the lower hair follicle, which may appear in a characteristic “swarm of bees” pattern. The affected hair follicles terminate their anagen phase prematurely and regress via the induction of massive apoptosis of the lower portion of the follicle (the catagen phase), which results in a resting hair follicle (the telogen phase). The hair follicles may then reenter the anagen phase, but in the presence of a lymphocytic infiltrate, the anagen is terminated prematurely, which results in miniaturized hair follicles. AA represents a disorder of hair follicle cycling in a dual sense: it almost exclusively attacks anagen hair follicles and then greatly disturbs hair follicle cycling by “catapulting” anagen follicles into the catagen phase.

The treatment of AA depends on the severity and extent of the disease. The medications include a topical irritant, and in mild cases, topical and intralesional steroids. More aggressive therapy is used for severe cases, however, such as systemic corticosteroids, immunosuppressive drugs, and immune modulators. These treatments frequently show side effects and a relatively high relapse rate, though. Recently, laser treatment of different wavelengths has been used to manage this problem.

Fractional photothermolysis is a recently introduced laser technique. It produces a unique thermal damage pattern called ‘microthermal treatment zones (MTZ)’ and characteristically spares the tissue surrounding each MTZ. It keeps the stratum corneum intact and gives ‘fractional’ microscopic thermal columns to the dermis, then creates a healing process that includes inflammatory cells, such as lymphocytes.

A 35-year-old male presented our hospital with a 2-year history of multiple large lesions of alopecia areata on the frontal region of the scalp (Fig. 1a).

He was treated with several methods, such as topical 5% monoxidil, topical steroid and intralesional corticoid injections, for two years but did not experience hair regrowth. After obtaining written informed consent, we treated him with fractional laser therapy (MOSAICTM Lutronic Corp., Korea) weekly for 24 weeks. A pulse energy of 10-15 mJ, and a density of 300 MTZ/cm²/pass were used, and two passes per session were performed. The treatment was well tolerated with no reported side effects. First, hair growth was already observed after 1 month. After 3 months, lesions were covered with 30% to 40% of mostly pigmented terminal hair. After 6 months of fractional laser therapy, there were complete regrowth in all lesions (Fig. 1b). And no relapse was observed during the follow-up period of six months. For this reason, patients were satisfied with the treatment outcome.

The mechanism of the fractional laser in inducing hair regrowth in AA lesions is thought to be the induction of T-cell apoptosis and enhancement of hair growth.

Numerous reports are supporting the hypothesis that laser, such as 308nm excimer laser, diode laser might induce hair growth in order to their ability to T-cell apoptosis or decreasing inflammation.

Another possible mechanism is a decrease in perifollicular lymphocytic infiltration through ‘scattering of perifollicular lymphocytes.’ The fractional laser therapy makes microscopic thermal columns in the dermis, and then creates a healing process that includes lymphocyte infiltrations. These phenomena may scatter perifollicular lymphocyte infiltration, which is a characteristic histologic feature of AA, around the column lesions. Therefore, fractional laser therapy may halt disease progression by arresting the hair follicles in the telogen stage of the hair cycle and increasing the anagen stage.
Furthermore, minor trauma and wound healing itself can drive hair growth. After wounding in mouse model, hair follicles form de novo neogenesis in skin. And this de novo hair follicular neogenesis is originated from non-hair-follicle stem cells. Therefore, fractional laser can also induce minor trauma and wound healing process which might facilitate hair growth. Even though there is no optimal therapeutic parameter yet for the fractional laser for AA, the authors treated with laser therapy until 24 weeks. These protocol may affect the overall outcome for success, because of persistent response was observed after 6 months in many previously reports which were treated by other laser modalities to AA. Until now, we have no idea which cytokines are key inducers of these interesting phenomena. In the near future, we hope this puzzle will be solved by physicians and scientists who major in hair biology.

References

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