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# Efficacy of Laser Treatment on Non-scarring Hair Loss

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## Abstract

Non-scarring alopecias are common and are due to various aetiologies. The usual methods for treating non-scarring alopecias may have adverse effects and cannot effectively address the problem. A modality that is currently studied at present is the use of light-based and laser treatments. It has been known for a long time that laser light promotes tissue repair and regeneration and that low level laser therapy stimulates cell activity. Laser treatment is also believed to stimulate anagen and telogen hair follicles, lengthen the anagen phase, encourage proliferation in active anagen hair follicles and stop early catagen. Furthermore, laser treatment has been confirmed to modulate inflammatory processes and immunological responses, which can also have an impact in hair regrowth. This review aims to find out whether laser treatment is effective in treating non-scarring alopecias, such as AGA, AA and other causes. Laser therapy speeds up hair regrowth in AA sufferers and leads to greater increase in terminal hair density; it also leads significant upgrades in overall hair regrowth, slowing of hair loss, thicker hair, good scalp health and hair shine. Overall, laser treatment is a safe and effective treatment for non-scarring alopecias. Further research is needed to find out more about its potential risks as well as its other applications in hair loss.

**Keywords:** Non-scarring alopecia • Non-scarring hair loss • Hair loss • Alopecia

## Review

It has been known for a long time that laser light promotes tissue repair and regeneration and that low level laser therapy stimulates cell activity. Low level laser therapy has been proven to be useful for a lot of medical conditions like wound healing, nerve regeneration, relief of joint pain, stroke recovery, and the prevention and remedy of mucositis [2].

Laser treatment is also believed to stimulate anagen and telogen hair follicles, lengthen the anagen phase, encourage proliferation in active anagen hair follicles and stop early catagen. Evidence indicates that LLLT acts on the mitochondria and can modify cell metabolism thru photodissociation of inhibitory Nitric Oxide (NO) from cytochrome c-oxidase (CCO), further causing increased ATP production, modulation of reactive oxygen species, and induction of transcription factors [3].

These transcription elements further cause protein synthesis that triggers other effects, which include accelerated cell proliferation and migration, alterations in cytokines, growth factors and inflammatory mediators, and tissue oxygenation.

Furthermore, laser treatment has been confirmed to modulate inflammatory processes and immunological responses, which can also have an impact in hair regrowth.

This review aims to find out whether laser treatment is effective in treating non-scarring alopecias, such as AGA, AA and other causes.

## Results

A total of thirty-one (31) studies were gathered and included in this review.

In order to test the effect of linear polarized infrared irradiation in the treatment of AA, a study was carried out with 15 patients (6 males, 9 females) using Super Lizer™, a medical tool emitting polarized pulsed linear light with a high output (1.8 W) of infrared radiation (600-1,600 nm) that is able to penetrate into deep subcutaneous tissue. The scalp was irradiated for three minutes for each week or every other week until vellus hair regrowth in at least 50% of the affected region is observed. As a result, in 47% of the sufferers' hair, there was an increase in hair growth within 1.6 months earlier in irradiated areas than in non-irradiated regions. It was observed that Low Level Laser Therapy (LLLT) simply speeds up hair regrowth in AA sufferers [4].

Using 655 nm red light and 780 nm infrared light every day for 10 minutes, 24 male AGA patients were handled and evaluated by a set of investigators. Following 14 weeks of treatment, growth in hair density on both the vertex and occiput in addition to anagen/telogen ratio were present and 80% of the patients were reported to be happy with the treatment [5].

Satino et al. tested the efficacy of low level laser treatment on the growth of hair and tensile strength on 28 male and 7 female AGA sufferers. Each patient was given a HairMax LaserComb® 655 nm, to apply at home for 6 months, for 5 to 10 minutes every other day. There was greater improvement within the vertex area for adult males

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and within the temporal region for women but both sexes benefited in all regions notably. In hair counts, each sexes and all areas had massive improvement (for temporal location: 55% in females, 74% in males, in vertex region: 65% in females, 120% in males) with vertex regions in males having the best results [6].

The HairMax LaserComb tool was examined by Leavitt et al. in a double-blind, sham device-controlled, multicenter, 26-week trial randomized study of 110 male AGA sufferers. Patients used the device three times every week for 15 minutes for a total of 26 weeks. Significantly greater increase in terminal hair density has been observed. Significant upgrades in overall hair regrowth, slowing of hair loss, thicker hair, good scalp health and hair shine were also demonstrated in the patient's evaluation at 26 weeks over baseline [7].

Recently, a double-blind randomized trial done by Lanzafame et al. of a helmet containing 21, 5 mW lasers and 30 LEDs for every other day for 16 weeks mentioned 35% growth in hair among male AGA sufferers. A double-blind randomized controlled trial was done to outline the safety and physiologic results of low-level laser treatment in men with androgenic alopecia. Forty four (44) men (18-48 years old, Fitzpatrick I-IV, Hamilton-Norwood IIa-V) had been recruited. The treatment group received a "TOPHAT655" unit containing 21, 5 mW lasers (655 ± 5 nm), and 30 LEDS (655 ± 20 nm), in a bicycle-helmet like apparatus. Patients were treated at home for every other day for 16 weeks (60 treatments, 67.3 J/cm(2) irradiance/25 minute treatment), with follow-up and images at 16 weeks. Low level laser treatment of the scalp at 655 nm considerably improved hair counts in males with androgenetic alopecia [8].

Another latest observation by Kim et al. was done in a 24 weeks randomized, double-blind, sham device-managed multicenter trial among both male and female AGA sufferers in order to find out more about the efficacy of a helmet type low level laser therapy tool combining 650 nm laser with 630 and 660 nm LEDs. Even though hair thickness and hair density accelerated substantially within the treatment group, there was no outstanding distinction in global appearance [9].

Findings from a different trial done by Avram and Rogers had been in accordance with these effects in which low level laser treatment accelerated hair count and shaft diameter, but blinded global photographs did no longer help these observations [10].

Endre Mester first observed that mice treated with lasers during experiments investigating the potential cancerous outcomes of lasers regrow hair in shaved areas significantly faster than unexposed mice in 1967 [11].Other investigators eventually observed that a few patients exhibited paradoxical hair growth at the periphery of regions treated with lasers for hair removal or adjoining to lesions dealt with laser sources. These observations stimulated others to analyze the consequences of low level laser therapy in male and female androgenetic alopecia [12].

Afifi et al. in 2016 conducted a systematic review to identify articles on Medline, Google Scholar, and Embase that were posted between January 1960 and November 2015. Eleven trials were evaluated, which investigated a total of 680 sufferers, including 444 adult males and 236 females. Nine out of eleven studies that assessed hair counts or hair density discovered statistically widespread enhancements in both men and women after laser treatment. Additionally, hair thickness and tensile strength appreciably improved in two out of four trials. Patient satisfaction was found in five studies, and became positive, although not as profound as the objective outcomes. Thus most of these studies were able to show that there is a common improvement in hair regrowth, thickness, and satisfaction following laser therapy [13].

A prospective controlled study evaluated whether neodymium: yttrium aluminum garnet (Nd:YAG) or fractional carbon dioxide lasers may stimulate the growth of new hair on patients with alopecia areata. Thirty-two patients who had long-standing and treatment refractory diseases had been recruited for the trial. At the end of this trial, there has been no statistically sizeable difference in the mean hair count for the three patches. In 7 of 32 patients (22%), an increase in the average hair count was seen at the scalp which includes the control patch. In this study, Nd:YAG or fractional carbon dioxide lasers did no longer increase the mean hair count on the AA patches which were treated in comparison with the control patch [14].

An assessment was done on the results of low level laser treatment on individuals with hair loss (Male Pattern Hair Loss (MPHL), Female Pattern Hair Loss (FPHL), Alopecia Areata (AA), and Chemotherapy-Induced Alopecia (CIA). The authors found that these low level laser treatment devices are both secure and powerful in patients with MPHL and FPHL who did not respond or have been not tolerant to traditional treatments [15].

Some studies have used the 308-nm excimer laser in the treatment of Alopecia Areata (AA). Photographic assessments of both dermatologists and individuals of the general populace confirmed objective improvements after excimer laser remedy. On the treatment side, the hair count and hair diameter had statistically increased after treatment. However, the hair diameter was substantially higher in the treated half compared with the control. The 308-nm excimer laser has a healing impact on AA that is established via photograph and phototrichogram analysis through assessment [16].

Ablative fractional lasers appear to be powerful in inducing hair regrowth through activation of the Wnt/β-catenin pathway in vivo. Ablative CO2 fractional laser was applied in the shaved dorsal skin of seven-week-old C57BL/6 mice whose hair is in the telogen stage. After 12 mice have been treated at various energies (10-40 mJ/spot) and density (100-400 spots/cm(2)) settings to decide the right dosage for maximal effect. The more effective dosage is the 10 mJ/spot and 300 spots/cm (2) setting. The anagen conversion of hair was observed in the histopathological examination, at the same time as Wnt/β-catenin expression was associated with hair regrowth within immunohistochemistry and molecular research [17].

Identification of methods to encourage anagen access can be useful for alopecia. Recently, nonablative lasers have been proposed as a treatment for alopecia. In one trial, the dorsal skin of 8-week-old female C57BL/6 mice with hair follicles in synchronized telogen was shaved and irradiated with a 1,550-nm fractional erbium-glass laser with varied beam energies (5-35 mJ) and beam densities (500-3500 microthermal zones/cm(2)) [18].

Excimer laser, composed of a noble gas and halide which repel each other, has changed into a typical mode of action in confronting several skin disorders. Of those ultraviolet B rays which contain beams of varied wavelengths, the 308 nm xenon-chloride is the most

realistic in dermatology. The benefits of monochromatic excimer laser over photo therapies of other types have been depicted as lower UV dose exposure, shorter course of treatment and for the maximum part, the possibility of being directed at distinct sites of skin instead of compromising the adjoining normal skin. Both 308-nm excimer lamp and 308-nm excimer laser initiate the regrowth of hair in patchy alopecia areata in children and adults, with the maximum impact on the scalp lesions regardless of no detectable changes in the lesions of extremities [19].

A retrospective observational trial of male and female sufferers of AGA evaluated the efficacy and protection of low-level laser therapy for AGA, both as monotherapy or as a concomitant remedy with minoxidil or finasteride, in an office setting. Subjects had been treated with the 655 nm-HairMax Laser Comb, in an office setting. Efficacy was assessed with global photographic imaging. Of 32 sufferers (21 women, 11 men), 8 showed significant, 20 moderate, and 4 no improvement. Improvement was visible both with monotherapy and with concomitant therapy. Improvement was found as early as three months and became sustained as much as 24 months. No unfavorable reactions had been noted. Low level laser treatment represents a possibly effective treatment for both male and female AGA, either as monotherapy or as concomitant remedy. Combination treatments with minoxidil, finasteride, and LLLT can also act synergistically to increase hair growth [20].

A multicenter, randomized, sham device-controlled, double-blind trial was performed to determine whether or not treatment with a low-level laser device, the HairMax Lasercomb, will increase terminal hair density in both males and females with pattern hair loss. The authors discovered a statistically sizable distinction in the growth in terminal hair density among lasercomb and sham-treated subjects. No serious side effects have been noted [21].

A feasibility study was carried out on men between the ages of 20 and 60 years who have been experiencing active hair loss within a year and the diagnosis of AGA. They also had a Norwood-Hamilton classification of 3, 3A, three V, 4, 4A, or 5 for the hair thinning patterns and skin type I, II, III, or IV on the Fitzpatrick skin type scale. A statistically significant trend in hair growth was seen [22].

In a rat model of chemotherapy-induced alopecia, it was determined whether or not low level laser treatment may promote hair regrowth. Rats receiving laser treatment regrow hair 5 days earlier than rats receiving chemotherapy or sham laser treatment (with the laser turned off). Laser treatment drastically extended hair regrowth after chemotherapy-triggered hair loss without compromising the efficacy of chemotherapy within the rat model [23].

The efficacy and safety of a 1550 nm fractional erbium-glass laser for hair loss was determined. Twenty eight ethnic South Korean subjects with varying hair loss have been enrolled in this study. Patients received ten treatments with a 1550 nm fractional Er:Glass Laser at 2-weeks intervals with the use of the same parameters (5-10 mm tip, 6 mJ pulse energy, 800 spot/cm(2) density, static mode). After five months of laser treatment, hair density had a marked increase to 157 ± 28/cm (2), and hair thickness additionally increased to 75 ± 13 μm [24].

A low-level laser comb was examined as to whether it may alleviate the signs of AA in a C3H/HeJ mouse model for AA. Twelve (12) mice with AA were randomized into groups; group I acquired treatment with HairMax LaserComb (wavelength: 655 nm, beam diameter <5 mm; divergence 57 mrad; 9 lasers) for 20 s every day, three times in a week for around 6 weeks; group II was treated with the same method, except that the laser was off (sham treatment). After 6 weeks of Laser Comb treatment, hair regrowth was found in all mice in group I (laser-treated) but none in group II (sham-treated). In histology, there was an increase in anagen hair follicles among mice treated with lasers [25].

A mouse model for alopecia was examined to recognize the clinical outcomes of a 1,550-nm fractional erbium-glass laser at the hair cycle and on male pattern hair loss (MPHL). Irradiation was done on shaved skin of mice using various energy and density settings and at various irradiation durations. In a study concerning human subjects, 20 volunteers had been treated over five sessions at 2-week intervals. A fractional photothermolysis laser was utilized at 5 mJ and a total density of 300 spots/cm (2). In the animal study, the hair stimulation outcomes have been structured upon the energy levels, density, and irradiation intervals. The anagen conversion of hair and the growth in Wnt 5a, β-catenin signals were determined. In the pilot study, incremental enhancements in hair density and growth rate have been evident [26].

One study examined the effectiveness of the 308-nm excimer lamp for the treatment of alopecia areata. Three sufferers with single alopecia areata lesions that have been resistant to conventional treatment have been recruited. The lesions have been exposed to a 308-nm excimer lamp at 2-weekly durations. Hair regrowth was noticed in all 3 patients after approximately 10 treatment sessions. Apart from erythema, there were no widespread adverse outcomes [27].

Another study was done to investigate the effect of helium-neon (He-Ne) laser (632.8 nm) irradiation on the hair follicle growth of testosterone-treated mice. There was an increase in the length of hair follicles and % anagen, indicating stimulation of hair growth [28].

A randomized, double blind controlled multicenter trial assessed the safety and effectiveness of the HairMax LaserComb laser phototherapy device in promoting hair growth and in the cessation of hair loss in men with androgenetic alopecia (AGA). Of the 110 patients who finished the study, volunteers who had HairMax LaserComb treatment exhibited an increase in terminal hair density. Significant upgrades in overall hair regrowth have been demonstrated in terms of patients' subjective evaluation at 26 weeks over baseline. The HairMax LaserComb was well tolerated with no serious adverse events.

The consequences of the 308-nm excimer laser within the remedy of alopecia areata were studied. Eighteen patients with 42 recalcitrant patches had been enrolled in this examine. The lesions have been dealt with the 308-nm excimer laser twice a week for 12 weeks. Regrowth of hair was found in 17 (41.5%) patches. Thirteen of the 18 lesions in scalp had complete regrowth of hair [29].

A study was carried out to evaluate the effects of the pulsed infrared diode laser (904 nm) within the treatment of alopecia areata. Sixteen sufferers with 34 resistant patches that had no responses to treatment modalities for alopecia areata had been enrolled in this study. Patients underwent treatment on a four-session basis, once every week, with a pulsed diode laser (904 nm) at a pulse rate of 40/s. Regrowth of hair was seen in 32 patches (94%). The regrowth

of hair appeared as terminal hair with its original coloration in 29 patches (90.6%), while 3 patches (9.4%) was regarded as a white villous hair. In patients who had response, it was detected as early as 1 week after the first session in 24 patches (75%), while 8 patients (25%) started to show response from the second treatment session [30].

A case record has been cited about effectively dealing with two sufferers whose alopecia areata had worsened steadily for 3 and 14 weeks. The treatment used a 308 nm xenon chloride excimer laser (dosage of 300-2,300 mJ/cm (2) per session). After 11 and 12 sessions in the 9 weeks and 11 weeks period, the whole focus showed homogenous and thick regrowth. No relapse was found during the duration of 5 and 18 months [31].

### Safety and Possible Side Effects

Laser treatment was proven to have a remarkably low prevalence of negative outcomes while it has been used over 50 years for various diseases and in several areas of the body. In hair growth, the only adverse event was the temporary occurrence of temporary hair loss developing within the first 1–2 months after starting Laser comb treatment, which disappears on continuous treatment [6]. The other possible considerations are the presence of dysplastic or malignant lesions at the scalp which will be stimulated to develop with the proliferative effects of laser treatment [11].

## Discussion

Laser light is said to promote tissue repair and regeneration as well as stimulate cell activity. It is also believed to stimulate anagen and telogen hair follicles, lengthen the anagen phase, encourage proliferation in active anagen hair follicles and stop early catagen. Furthermore, laser treatment has been confirmed to modulate inflammatory processes and immunological responses, which can also have an impact in hair regrowth.

In this review, we have learned that low level laser therapy speeds up hair regrowth in AA sufferers. Significantly greater increase in terminal hair density has also been observed, as well as significant upgrades in overall hair regrowth, slowing of hair loss, thicker hair, good scalp health and hair shine. Low level laser treatment of the scalp was able to considerably improve hair counts in males with androgenetic alopecia. Additionally, hair thickness and tensile strength appreciably improved in some trials.

Laser treatment was able to bring about improvements in hair regrowth, thickness, and satisfaction. Laser devices are both secure and powerful in patients with MPHL and FPHL who did not respond or have been not tolerant to traditional treatments. Both 308-nm excimer lamp and 308-nm excimer lasers initiate regrowth of hair in patchy alopecia areata in children and adults, with maximal impact on the scalp lesions. With the 655 nm-HairMax Laser Comb, improvement was found as early as three months and became sustained as much as 24 months.

In chemotherapy-triggered hair loss, laser treatment drastically extended hair regrowth without compromising the efficacy of chemotherapy in rats. Combination treatments with minoxidil, finasteride, and laser treatment can also act synergistically to increase hair growth. No unfavorable reactions had been noted in most trials, suggesting its safety and efficacy.

## Conclusion

Overall, laser treatment is a safe and effective treatment for non-scarring alopecias. Further research is needed to find out more about its potential risks as well as its other applications in hair loss.

## Conclusion

Prevalence of pressure ulcer due to medical devices in ICU is high. Various medical devices can cause pressure ulcer. Assessment and preventing is important to reduce the risk of pressure ulcers.

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