ACTAS Dermo-Sifiliográficas 112 (2021) 99–102

ACADEMIA ESPAÑOLA DE DERMATOLOGÍA Y VENEREOLOGÍA

ACTAS Dermo-Sifiliográficas

Full English text available at www.actasdermo.org

OPINION ARTICLE

Low-level laser therapy for androgenetic alopecia☆

Láser de baja potencia para tratar la alopecia androgénica

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Received 3 December 2019; accepted 26 March 2020

Androgenetic alopecia (AGA) or male-pattern baldness is a the most frequent type of hair loss. The pathophysiology of AGA involves a genetic predisposition leading to an exacerbated response of hair follicle cells to androgens in certain areas of the scalp, which is worsened by scalp inflammation and extrinsic factors. A gradual decrease in hair follicle activity occurs, with the hair follicle decreasing in size until total atrophy of the hair bulb and associated hair loss occur. Different treatments have been proposed such as minoxidil or finasteride, but in some cases, the outcomes are not satisfactory. In recent scientific studies, low-level laser therapy (LLLT) has been proposed as a treatment for AGA.[1]

In a review by the Taiwanese authors Liu et al.[2] published in 2019, the effectiveness of LLLT in the treatment of AGA in adults was studied. The quantitative analysis showed a significant increase in hair density for those patients treated with LLLT compared with the sham group. A subgroup analysis showed that LLLT increased hair growth in both sexes, in both comb- and helmet-type devices, and for short- and long-term treatment courses. The subgroup analysis also showed a more significant increase in hair growth for LLLT in the group who received low-level treatment compared with group who received high-level treatment. The wavelengths used in the studies in the review ranged from 630 to 808 nm. Furthermore, the low-frequency regimen (less than 60 min per week) appeared more effective than the high-frequency regimen (more than 60 min per week). The authors of the study concluded that LLLT is a potentially effective treatment for AGA in men and women.

In a study conducted in Thailand by Suchonwanit et al.[3] and published in 2019, a new LLLT device for domestic use, RAMACAP, was evaluated at a wavelength of 655 ± 20 nm. Forty subjects with AGA were randomly assigned to home treatment with a laser helmet (RAMACAP) or a sham device. The treatment regimen was 20 min per session, 3 times a week, for a period of 24 weeks. Hair density, hair diameter, and adverse events were assessed at the start of the study and at weeks 8, 16, and 24. At week 24, the laser helmet was significantly superior to the sham device for increasing hair density and diameter, and it showed a significantly greater improvement in global photographic assessment for both investigator and subject scores. Side effects included temporary hair shedding and scalp itching. The results therefore suggested that the new helmet-type LLLT device is an effective treatment option for AGA. The limitations of this study are the small sample size and the lack of long-term follow-up.

In a review by the US authors Afifi et al.[4] published in 2017, the effectiveness of LLLT in AGA was evaluated based on objective outcome measures and patient satisfaction. The wavelengths used ranged from 630 to 780 nm; the duration of the sessions varied by study between 8 and 25 min and the treatment duration was between 24 weeks and 24 months. The results showed a general improvement in hair regeneration, thickness, and patient satisfaction in all studies, but particularly in those that used a wavelength of 655 nm. LLLT appears to be a promising monotherapy for AGA and may serve as an alternative for those who do not want to use medical therapy or undergo surgery.

In a study conducted in Iran by Faghihi et al.[5] published in 2018, the authors assessed the effectiveness of combining LLLT with a topical solution of minoxidil in the treatment of AGA. The study included 50 patients. Patients in the study group received 20 drops of topical minoxidil 5%, twice a day,

☆ Please cite this article as: Martínez-Pizarro S. Láser de baja potencia para tratar la alopecia androgénica. Actas Dermosifiliogr. 2021;112:99–102.

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for 6 months, plus 2—3 sessions of 20 min of LLLT at a wavelength of 785 nm per week for 24 weeks. The control group received a topical solution of minoxidil 5% in the same way as the study group and they used a laser comb system, which was switched off during use, to act as a placebo. The percentage recovery of AGA, mean hair density, diameter, and satisfaction of the patients with treatment were significantly greater in the study group compared with the control group.

In a study conducted in the United States by Friedman and Schnoor[6] and published 2017, the effectiveness of LLLT, also denominated photobiomodulation, was analyzed. In the study, the human hair follicles and surrounding tissue structures were exposed to laser light using a device fitted with diode lasers operating at a wavelength of 650 nm, placed within a sports cap to promote discretion while in use. The study demonstrated that treatment with LLLT of the scalp with the device every 2 days for 17 weeks is a safe and effective treatment for AGA in healthy women aged 18–60 years with Fitzpatrick skin type I to IV and Ludwig-Savin baldness scale I-1 to II-2 baldness patterns. Participants who received LLLT at 650 nm achieved an increase of 51% in hair counts in comparison with sham-treated control patients.

In a study conducted in Thailand by Panchaprateep et al.[7] and published in 2019, LLLT was assessed for promoting hair growth in vivo. The authors measured the changes in protein expression in dermal papillary tissue in male patients with AGA. The treatment was applied at home for 25 min per session every 2 days for 24 weeks at a wavelength of 655 nm. The analysis revealed 11 statistically significant proteins. Another analysis showed that these proteins are implicated in several biological processes, such as regulation of cell transcription, protein biosynthesis, cell energy cycles, lipid homeostasis, extracellular matrix, cell-cell/cell-matrix adhesion, and angiogenesis. Moreover, LLLT increased the main extracellular matrix proteins, and this resulted in a clinical improvement in hair diameter in patients with AGA. The findings support the benefit of LLLT in the treatment of AGA.

A study conducted in Iran by Barikbin et al.[8] and published in 2017 investigated the effectiveness of a combination of 2 wavelengths of low-power diode laser scanner (665 nm and 808 nm) for stimulating hair growth in AGA. Ninety patients with AGA were randomly assigned to 1 of 3 groups. The first group received red light at 655 nm via a laser hat, the second received red light at 655 nm as well as infrared light at 808 nm with a laser scanner of hair growth device, while the third group was the control group. Details of the therapeutic regimen in this study were not provided. The patients in the laser scanner group had better outcomes and showed a greater increase in terminal hair density in comparison with the laser hat group and the control group. The study showed that treatment with a new laser device achieved promising results without any observable adverse effects.

In a study conducted in Taiwan by Mai-Yi Fan et al.[9] published in 2018, the effectiveness and safety of LLLT was assessed for the treatment of AGA. This randomized, double-blind, self-comparative, 24-week, study with a sham device as control enrolled 100 patients with AGA. All participants received LLLT 3 times a week for 30 min per session, over a period of 24 weeks at a wavelength of 650 ± 10 nm on a randomly assigned side of the scalp while the contralateral side received sham treatment. After 24 weeks of treatment, the scalp treated with LLLT had significantly greater hair coverage than the side that received sham treatment (14.2% compared with 11.8%). A significant improvement was also observed with respect to baseline in hair thickness, hair count, hair coverage, and overall investigator assessment of the side treated with LLLT compared with the side that received sham treatment at week 12 and 24. No serious adverse effects were reported. Therefore, use of LLLT could be an effective, safe, and well-tolerated treatment for AGA.

In a study conducted in Canada by Gupta and Carviel[10] and published in 2019, the efficacy of LLLT in the treatment of AGA was assessed. A meta/analysis was used to evaluate treatment efficacy. In addition, a subanalysis was performed to determine whether the type of device used or the use of lasers instead of light emitting diodes (LED) had a significant impact on outcomes. The results showed that LLLT could be used to effectively treat AGA. The specific device recommendations should be based on the use of lasers instead of LEDs and not on the type of device (comb/hat/helmet).

Table 1 summarizes the characteristics of the studies analyzed.

If LLLT is compared with other therapeutic options such as, for example, minoxidil or finasteride, the available studies suggest that LLLT is more effective than these options if evaluated on its own. But LLLT combined with minoxidil and finasteride was even more effective due to synergies arising between the 2 treatment modalities.[11] Furthermore, it is of note that while surgery is even more effective than LLLT, LLLT offers an option to those individuals who are reluctant to accept the risks of an operation.[12]

The current literature has hardly any negative articles on LLLT or articles that show that this therapy is not effective. These studies lack a robust methodology, are not conducted in patients with AGA, or are old studies.

Taking into account the scientific evidence provided by the results from in the studies described above, conducted in recent years, in different countries (Taiwan, United States, Thailand, Canada, Iran), LLLT would appear to be a promising option in both men and women with AGA.

These studies show that LLLT is an effective, well-tolerated treatment with a good safety profile, good synergy with other products, and with few, mild adverse effects. Therefore, in view of the published evidence, healthcare professionals may be interested in this novel therapy for their everyday work, particularly when faced with patients who want to avoid other more invasive therapies.

It is however important to note that although the evidence reviewed appears to show that the therapy can yield positive outcomes, the limited number of studies in humans and the small sample sizes of the studies considered mean that they do not provide strong enough evidence to establish general recommendations. Furthermore, it should be remembered that many of these studies are sponsored by manufacturers (and so are subject to conflicts of interest).

There is thus a need for more high-quality clinical trials in this field with a robust design. This would enable an evaluation of the efficacy and possible complications of this treatment in the short and long term and in more patients. Information would be provided regarding cost-effectiveness and synergies with other therapies could be explored, along

Table 1 Characteristics of the studies analyzed.

Author	Title	Year Place	Journal	Wavelength	Therapeutic Regimen
Liu et al.	Comparative effectiveness of low-level laser therapy for adult androgenic alopecia: a system review and meta-analysis of randomized controlled trials	2019 Taiwan	Lasers Med Sci.	Ranged from 630 to 808 nm	Low frequency regimen (less than 60 min per week) appeared more effective than the high frequency regimen (more than 60 min per week)
Suchonwanit et al.	Low-level laser therapy for the treatment of androgenetic alopecia in Thai men and women: a 24-week, randomized, double-blind, sham device-controlled trial	2019 Thailand	Lasers Med Sci.	655 ± 20 nm	20 min per session, 3 times a week, for 24 weeks
Afifi et al.	Low-level laser therapy as a treatment for androgenetic alopecia	2017 United States	Lasers Surg Med.	Between 630 and 780 nm	The session duration varied by study between 8 and 25 min and the treatment duration was between 24 weeks and 24 months.
Faghihi et al.	The effectiveness of adding low-level light therapy to minoxidil 5% solution in the treatment of patients with androgenetic alopecia	2018 Iran	Indian J Dermatol Venereol Leprol.	785 nm	Patients in the study group received 20 drops of topical minoxidil 5%, twice a day, for 6 months, plus 2—3 sessions of 20 min of LLLT at a wavelength of 785 nm per week for 24 weeks.
Friedman and Schnoor	Novel approach to treating androgenetic alopecia in females with photobiomodulation (low-level laser therapy)	2017 United States	Dermatol Surg.	650 nm	The treatment regimen was applied every 2 days for 17 weeks
Panchaprateep et al.	Quantitative proteomic analysis of dermal papilla from male androgenetic alopecia comparing before and after treatment with low-level laser therapy	2019 Thailand	Lasers Surg Med.	655 nm	Treatment was applied at home for 25 min per session every 2 days for 24 weeks.

Table 1 (*Continued*)

Author	Title	Year Place	Journal	Wavelength	Therapeutic Regimen
Barikbin et al.	Comparison of the effects of 665 nm low level diode laser hat versus and a combination of 665 nm and 808 nm low level diode laser scanner of hair growth in androgenic alopecia	2017 Iran	J Cosmet Laser Ther.	665 nm and 808 nm	Not specified
Mai-Yi Fan et al.	Efficacy and safety of a low-level light therapy for androgenetic alopecia: a 24-week, randomized, double-blind, self-comparison, sham device-controlled trial	2018 Taiwan	Dermatol Surg.	650 ± 10 nm	3 times a week for 30 min each session, for a period of 24 weeks
Gupta and Carviel	Meta-analysis of photobiomodulation for the treatment of androgenetic alopecia	2019 Canada	J Dermatolog Treat.	650 nm	Not specified

Source: Compiled by the authors

with the effects in different patient groups and the optimum number of sessions per week and their ideal duration. We could then offer patients better treatments and care based on the most recent scientific evidence.

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