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Original article

The use of phototherapy with different wavelengths in the treatment of Androgenetic Alopecia

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Abstract

Introduction: Phototherapy has been identified as a safe, non-invasive, and promising resource for the treatment of Androgenetic Alopecia (AGA). The aim of this study was to evaluate the effects of phototherapy on the treatment of AGA using two different wavelengths: red and blue. Both red and blue light, under the parameters tested in this study, allowed an increase in hair density, a reduction in the central parting, and promoted an increase in the number of terminal hairs after the treatments, as well as a reduction in vellus hairs.

Methodology: Ten volunteers were selected (GLV n=5) and (GLA N=5), all diagnosed with AGA and approved by the ethics committee with opinion number 5,761,579. Interventions were carried out using Vênus equipment (MMOptics, São Carlos, Brazil) with Group GLV λ=660nm, 4J and Group GLA λ=440 nm, 4J. The interventions were performed once a week, for 90 days, totaling 12 treatment sessions. Hair progression was assessed by photographic record and the ratio of vellus to terminal hairs was performed by digital trichoscopy imaging (Dino Lite; New Taipei City, Taiwan, China).

Results and Conclusion: Both red and blue light, under the parameters tested in this study, allowed an increase in hair density, a reduction in the central parting, and promoted an increase in the number of terminal hairs after the treatments, as well as a reduction in vellus hairs.

Keywords: Photobiomodulation; Alopecia; Hair loss; Trichology; Hair therapy.

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1. Introduction

Androgenetic Alopecia (AGA) is one of the most common causes of hair loss, mediated by androgenic hormones and inflammatory factors. In this pathology, terminal hairs gradually transform into vellus hairs, leading to hair miniaturization and subsequent baldness [1, 2]. Among the treatments for this condition, Minoxidil® and Finasteride are the most commonly used drugs; however, side effects from these medications have been reported by users [3]. Phototherapy, using low-power lasers or LEDs, has been identified as an effective, non-invasive treatment for AGA with no side effects, approved by the FDA (Food and Drug Administration) [4]. Red light, with wavelengths ranging from 625 nm to 740 nm, is the wavelength of choice for researchers and works by absorption by Cytochrome C Oxidase, promoting ATP synthesis by the Mitochondria, modulating Reactive Oxygen Species and Nitric Oxide with consequent influence on the Wnt/γ-catenin pathway [5].

Blue light, with wavelengths ranging from 415 nm to 495 nm, has been pointed out as a potential treatment for AGA by researchers who identified photoreceptors in the hair follicle such as OPNS2 and OPSN3 [6] and Cryptochrome 1 [7], enabling the absorption of this wavelength to promote reactions of mesenchymal cells in the dermal papilla, as well as anti-

inflammatory effects. The aim of this work was to evaluate the effects of phototherapy in the treatment of AGA, using two different wavelengths: red and blue.

2. Methodology

A prospective, randomized, blind clinical trial was conducted in Campinas, SP, with the approval of the Ethics Committee of Universidade Brasil, under opinion number 5.761.579. An initial anamnesis and clinical evaluation were conducted according to inclusion and exclusion criteria, and the selected participants (n=10) were randomly divided into two groups according to the therapeutic intervention: Red Light Group (GLV, n=5) and Blue Light Group (GLA, n=5) (Figure 1). The randomization was performed using a Mobile App Randomizer (GIANNIS MACHERAS). All volunteers were treated using the Vênus equipment (MMOptics, São Carlos, Brazil) applied to the affected area. Both groups received the same light energy density (4J) per point (Table 1).

The interventions were conducted once a week for 90 days, totaling 12 treatment sessions. Previously, the volunteers' hair was cleansed with a 0.5% chlorhexidine solution. The applications were made to the upper zone of the head, in areas affected by alopecia, in a pinpoint manner, at every 1 cm distance, totaling 16 points. All participants and the equipment operators wore protective glasses. The emergence of new hairs and the counting of vellus and terminal hairs were conducted using digital trichoscopy imaging (Dino Lite; New Taipei City, Taiwan, China). The Shapiro-Wilk test for normality was used for the statistical evaluation of the treated groups, and the paired T-test was used for comparing the means.

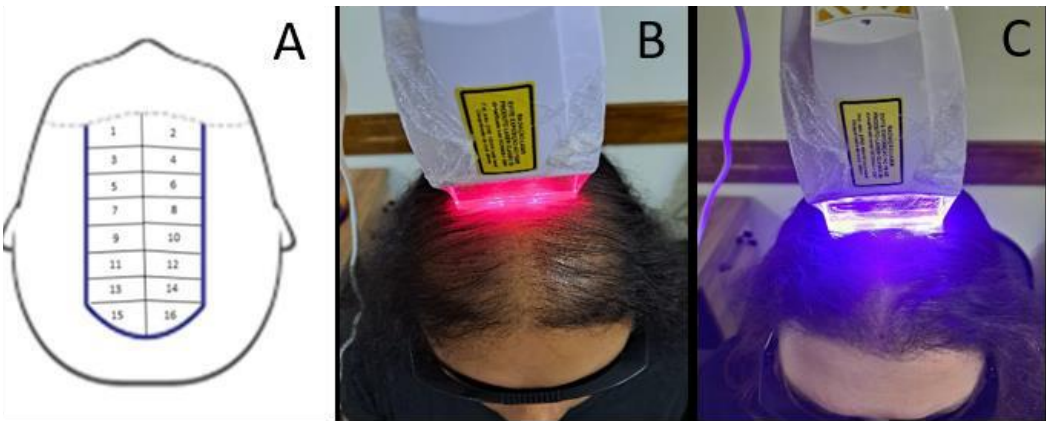

Figure 1. Illustrative image of the interventions. A. Application points. B. Red Laser. C. Blue LED.

Group GLV	
Diode	**Laser**
Wavelength	λ=660nm
Power	100mV
Time	40 seconds
Energy	4J/Ponto
Group GLA	
Diode	**Laser**
Wavelength	λ=440nm
Power	150mV
Time	30 seconds
Energy	4J/Ponto

Table 1. Parameters of irradiation applied. A. Group GLV (Red Light Group). B. Group GLA (Blue Light Group).

3. Results

In both treatments, with both red and blue light, improvements in hair density and a reduction in the central parting were observed. All volunteers reported an improvement in

the perception of their hair volume, and no volunteers reported discomfort or adverse effects (Figure 2 and 3). With the use of blue light (Figure 2), in addition to improved density, there was also an improvement in edematous aspects of the scalp and seborrhea, a condition related to skin inflammation.

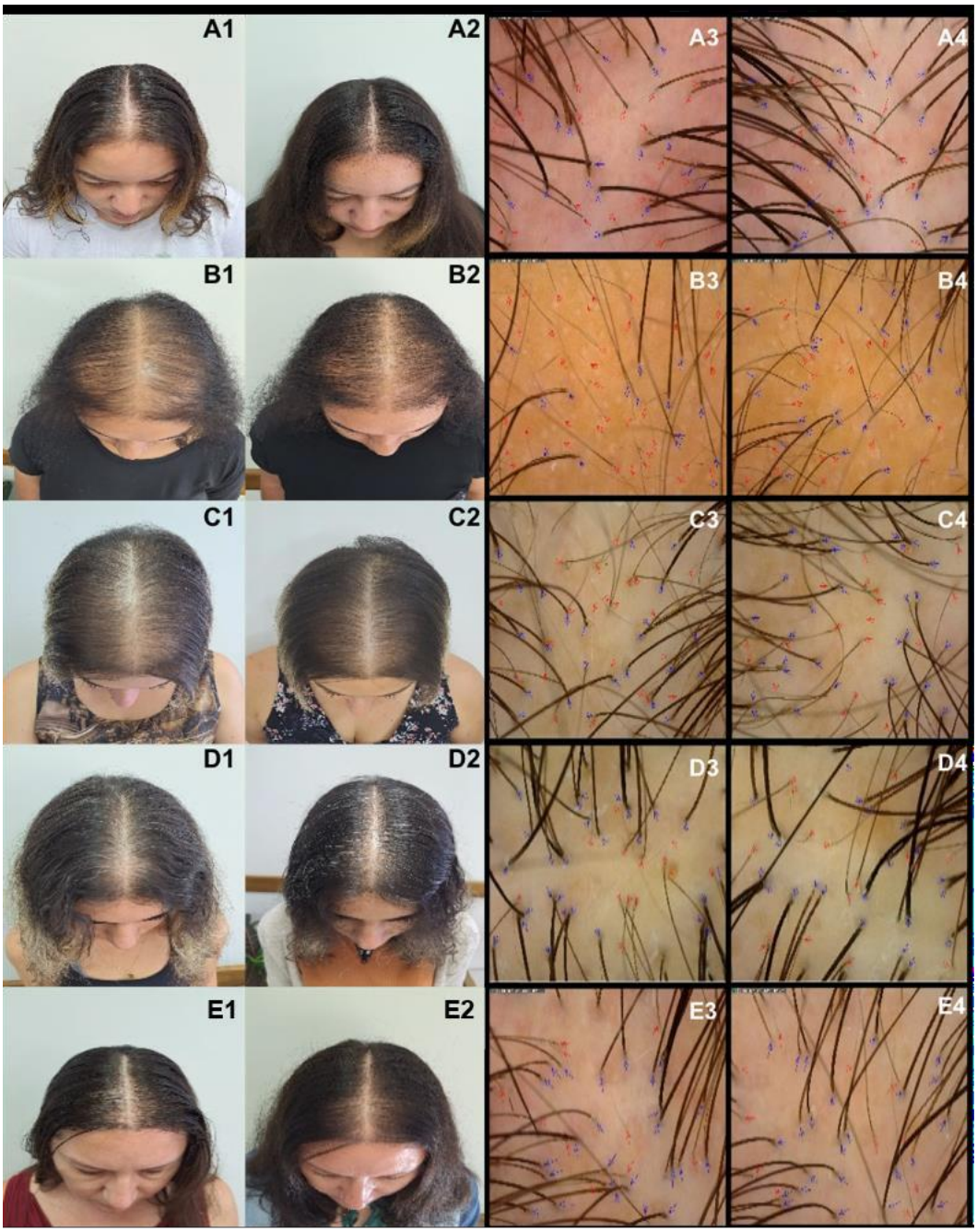

Figure 2. Photographic and trichoscopy images, before and after interventions with red light..

The trichoscopy count before and after irradiation with red light showed that there was a statistically significant increase in the number of terminal hairs ($p<0.05$), while the reduction in the number of vellus hairs with red light did not show a statistically significant difference ($p\geq0.05$) (Figure 4A). Regarding the number of terminal hairs before and after treatment with blue light, figure 4B shows that there was a statistically significant difference between the treated groups ($p<0.05$). Similarly, there was no statistically significant difference among the vellus hairs that were treated with blue light ($p\geq0.05$) (Figure 4B).

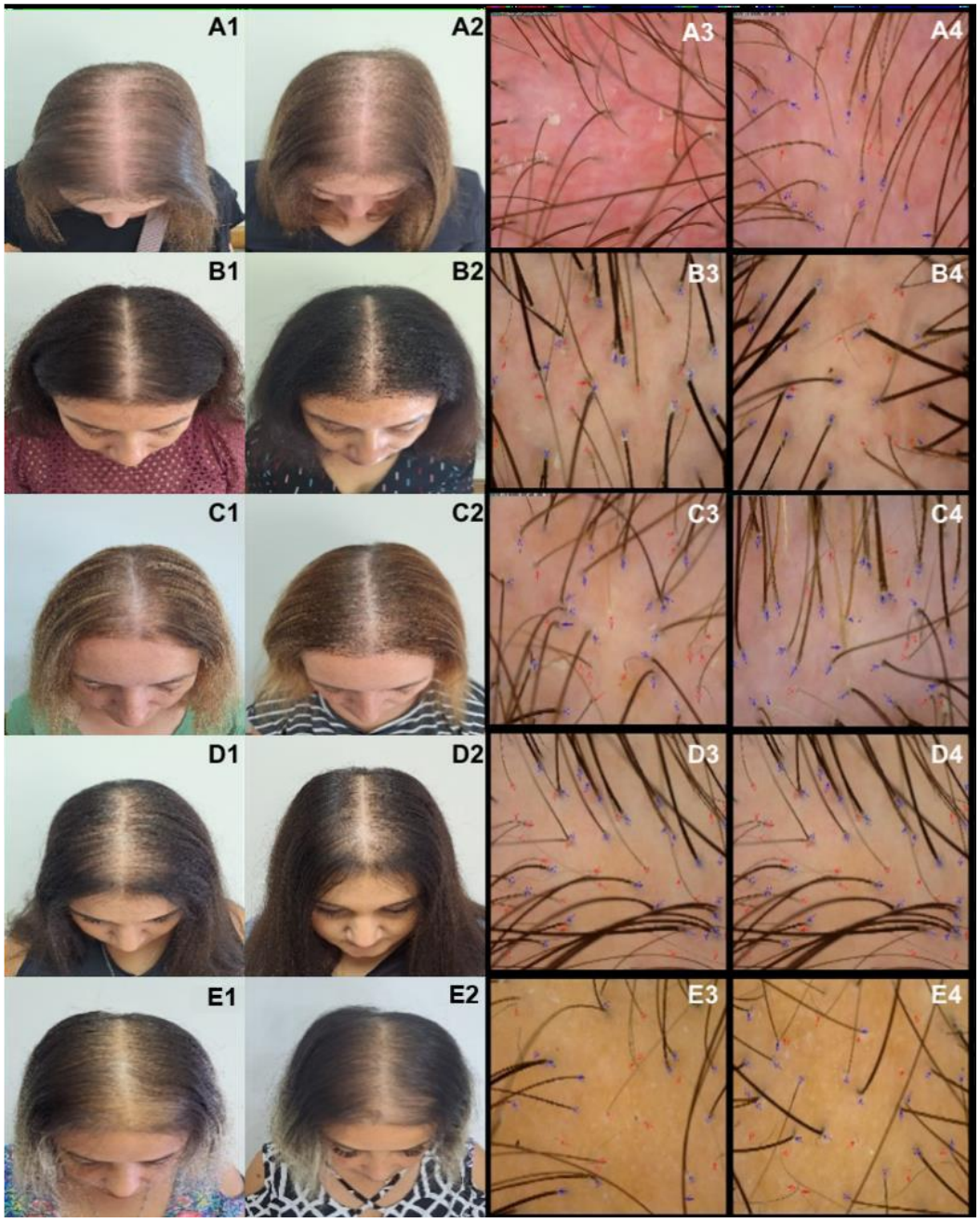

Figure 3. Photographic and trichoscopy images, before and after interventions with blue light.

Regarding the number of terminal hairs before treatment with red and blue light (Figure 5A), figure 5A shows that there was no statistically significant difference between the two treated groups ($p \geq 0.05$). Similarly, the different wavelengths used in the treatment of AGA (Androgenetic Alopecia) did not show statistically significant differences after treatments in both groups ($p \geq 0.05$) (Figure 5B). Regarding the number of vellus hairs before treatment with red and blue light (Figure 6A), figure 6A shows that there was no statistically significant difference between the two groups ($p \geq 0.05$). Similarly, the different wavelengths used in the treatment of AGA (Androgenetic Alopecia) did not show statistically significant differences after treatments ($p \geq 0.05$) (Figure 6B).

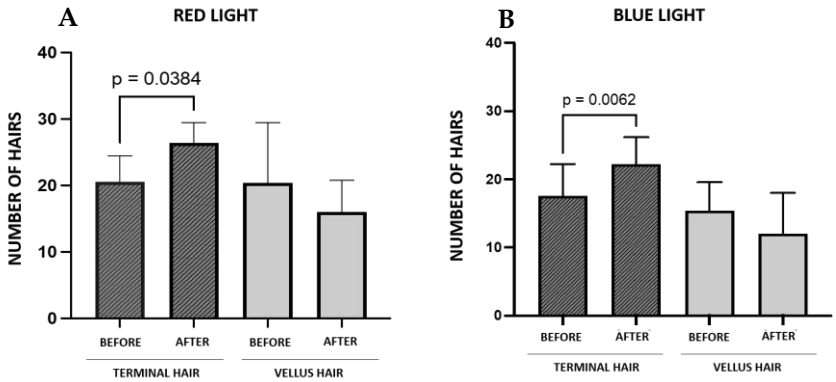

Figure 4. Graphical representation of the total number of terminal hairs and vellus hairs, before and after treatment with red (A) and blue (B) light.

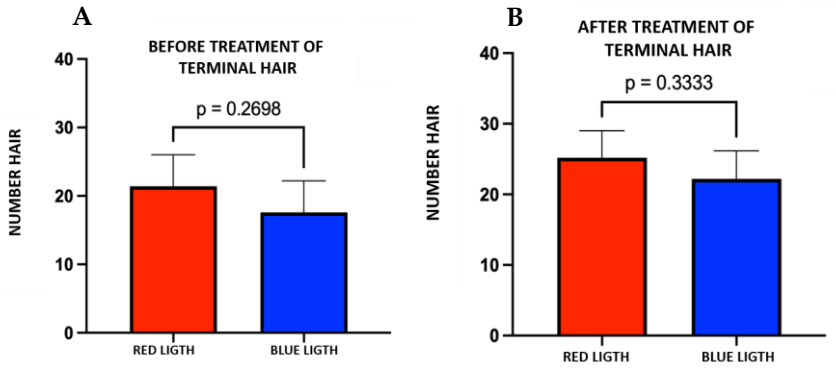

Figure 5. Graphical representation of the total number of terminal hairs, before (A) and after (B) treatment in the comparison of red light with blue light.

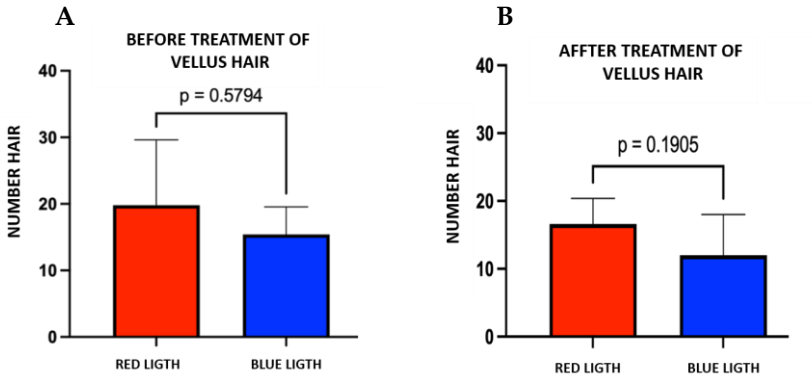

Figure 6. Graphical representation of the total number of vellus hairs, before (A) and after (B) treatment in the comparison of red light with blue light.

4. Discussion

We dedicate this study to seeking options that can promote hair improvement in individuals affected by Androgenetic Alopecia, as it is one of the conditions that most commonly causes hair loss, affecting both men and women and causing psychosocial discomfort and consequently impacting the quality of life of affected individuals. Red light emerges as a favorite for phototherapy treatment; however, new research points to the possibility of treatment with blue light with mechanisms like those of photobiomodulation. Through this study, it was possible to observe that both red and blue wavelengths, under the parameters tested here, promoted improvements in the volunteers' hair, with increased density and reduced central parting. Additionally, in this study, we evaluated the thickness of the hair affected by the pathology and observed that phototherapy altered the ratio between terminal and vellus hairs in both groups, thus allowing for the reduction of the central parting of the hair.

We also observed that the volunteers in the group treated with blue light, in addition to improvements in density, also experienced a decrease in scalp erythema and seborrhea, as well as an increase in hair color, findings consistent with those reported by Buscone et al. [6]. Given the benefits found in the results of this study regarding the use of red and blue light in the treatment of Androgenetic Alopecia, further studies are encouraged to evaluate the combined use of the two wavelengths. This approach could potentially increase the number of light receptors, thereby triggering simultaneously different mechanisms of action of phototherapy.

5. Conclusion

According to the results presented by comparing treatments with different wavelengths of light, it was found that phototherapy is effective, safe, and can be an option in the treatment of Androgenetic Alopecia (AGA). Both red and blue light, under the parameters tested in this study, allowed for increased hair density, reduced central parting, and promoted an increase in the number of terminal hairs after treatments, as well as a reduction in vellus hairs.

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