Original Research Article

LED LIGHT IN EPIDERMIS HYPERPIGMENTATION

ABSTRACT

Aging is a natural process that causes several changes in the body, especially the skin with the loss of tonicity and brightness, which makes frequent the search for longevity in society, and over time, dissatisfaction with the external image of the body worsens, so health care and skin have become a primary factor for self-esteem, social relations and quality of life. LED is a phototherapy feature that has been used for the treatment of skin hyperpigmentation. This research aims within this spectrum to analyze the results of the effect of LED light on hyperpigmentation in the epidermis. Systematic literature review through bibliographic research in the electronic databases of the Virtual Health Library - VHL: Latin American and Caribbean Literature on Health Sciences (LILACS); Scientific Electronic Library Online (Scielo), Pubmed-NCBI and Google Scholar, using the descriptors: hyperpigmentation, LED light, bleaching, epidermis, rejuvenation, and aesthetics. We analyzed 5 original articles that present similar objectives among themselves, seeking to understand the use of LED in the bleaching of hyperpigmentation of the epidermis and its other beneficial effects on the skin. Because of the studies, it can be concluded that LED light is an effective option not only in the bleaching of epidermis hyperpigmentation but also in other aspects such as hydration, rejuvenation, viço, and skin quality.

Keywords: LED light, Whitening, Epidermis, Rejuvenation, Hyperpigmentation, Aesthetics.

1. INTRODUCTION

The search for longevity has become something frequent in society, and over time, dissatisfaction with the external image of the body is aggravated, so health and skincare have become a primary factor, especially for self-esteem, social relationships, and quality of life [1].

The skin acts functionally as a protective wrap to the external environment and is considered the largest organ of the human body, acts controlling the loss of body fluids, avoiding the penetration of foreign and harmful substances to the body, functioning as a protective cover and a barrier impervious to many substances, and is divided into three layers with distinct functions: epidermis being the most superficial layer (external) and the main barrier of defense, dermis being the intermediate layer with vascularized tissue and hypodermic (deeper) consisting of fatty tissue [2].

Aging is a natural process that causes several changes in the body, especially the skin with the loss of tonicity and shine, forming folds, becoming flaccid, wrinkled, and hyperpigmented, and still suffers a reduction in the production of important components such as collagen and elastin [1].

Among the alterations presented by the aging process or response to aggressoragents hyperpigmentation is characterized by an increase in the number of melanocytes, and by the excessive production of melanin in the melanosomes, present in the dermis or epidermis. They are unaesthetic and may arise due to several factors, including aging and hormonal changes, such as the climacteric and menopause period [3].

Studies indicate a higher incidence of hyperpigmentation in individuals with darker hair, eyes, and skin, being more frequent in women than in men, is rare in childhood and light-skinned individuals, and also observe that it does not occur in the infant, showing to be more frequent in adults/young [4].

Pigmentary dyschromia is characterized by changes in skin tone, where lighter spots are called hypochromic and are caused by decreased epidermal melanin, and darker spots are hyperchromic that are produced by excess melanin production and may also be related to the lack of vitamin B, producing mostly an unaesthetic result [2].

For hyperpigmentation, there must be a stimulus in melanocytes, and this stimulation is due to internal or external factors that lead to excessive production of dermal or epidermal melanin and originates hyperchromic, which are called chloasma or melasma, ephelides or arda, lentigos, and post-inflammatory hyperchromic. These contribute to a constant increase in the demand for treatments aimed at delaying the chronological effects of aging [1].

In this sense, there are several non-invasive techniques in the area of Dermatofunctional Physiotherapy used for the treatment of both facial and body hyperchromic, one of them is the light emitter diode (LED), because it is painless and safe phototherapy, without side effects and recovery time, has become a promising and effective way to treat hyperchromic [3].

Phototherapy is a resource used to stimulate neocollagengenesis, analgesic, anti-inflammatory, healing, biomodulator, the activator of cellular metabolism, which increases the permeation of water and dermo-cosmetic nutrients, fights free radicals, has a bactericidal effect, lightens stains, restores skin integrity, moisturizes and moisturizes the face, being indicated for aesthetic treatments [5].

The energy resulting from the light of the LEDs, act directly on the cells, that is, on the permeability of the cell membrane, in their organelles that are the mitochondria, and in their physiological processes such as the synthesis of ATP [6].

The physiological effects happen by increasing metabolism and the cells that interact in our body with the emission of light, causing a photostimulation or photoinhibition response, crucial to scar processes, and acceleration of the inflammatory process [3].The use of coherent lights stands out as a bio stimulating method for tissue repair that increases cell

proliferation and collagen synthesis. For the stimulation of physiological effects, therapeutic laser diodes are used: red, with a wavelength of 660nm, infrared, with 808nm, blue LED with a wavelength range around ± 470nm and amber LED with a wavelength around ± 590nm [5]. In humans, there are chromophores in the skin that are photos dynamically active and photoenterable substances[7]. Chromophores are natural and external pigments, which encompass a group of atoms that gives color to a substance and absorbs light with a specific wavelength in the visible spectrum [8]. Currently, numerous chromophores are known for various phototherapeutic modalities, such as melanin, water, exogenous pigments, and photosensitizing drugs (psoralens and PDT photosensitizers) [7].

Evidence shows positive effects in the treatment of rejuvenation and repair of damage with blue LED light, as it is one of the most used phototherapies, has the bactericidal function, at the site of the application occurs an important reaction of stimulation of water molecules, thus causing the breakage of cell bridges that cause the stains promoting whitening effect, in addition to deep hydration of the skin [5].

With everything, few explanations specifically address the LED in the hyperpigmentation of the epidermis, even though its great benefits in skin whitening are evidenced. Thus, this research aims within this spectrum to analyze the results of the effect of LED light on hyperpigmentation in the epidermis.

2. MATERIALS AND METHODS

This study is characterized as a systematic literature review through bibliographic research conducted from August to September 2020, in open access publications available in Portuguese, Spanish, and English, in the electronic databases of the Virtual Health Library - VHL: Latin American and Caribbean Literature in Health Sciences (LILACS); Scientific Electronic Library Online (Scielo), Pubmed-NCBI and Google Scholar, to analyze the results of the effect of blue LED light on epidermis hyperpigmentation, using the following descriptors: hyperpigmentation, LED light, bleaching, epidermis, rejuvenation, and aesthetics.

The articles were selected according to the following inclusion criteria: articles up to 06 years of publication, original articles; be written in English, Spanish, or Portuguese and be related to descriptors. Publications that did not include the inclusion criteria were excluded.

Initially, 45,426 publications were selected, using the descriptors individually, the combination of the descriptors was subsequently used, following this combination method: hyperpigmentation and bleaching - 11 publications, LED light and whitening - 89 publications, rejuvenation and hyperpigmentation - 23 publications, epidermis and bleaching - 13 publications, aesthetics and bleaching - 485 publications, rejuvenation and LED light - 13 publications, epidermis and LED light - 32 publications, aesthetics and LED light - 31 publications, totaling 701 articles, were excluded in this stage 44,725. Subsequently, the following filters were used: full text, year, and language. It was then obtained for hyperpigmentation and bleaching - 0 publications, LED light and whitening - 25 publications, rejuvenation and hyperpigmentation - 11 publications, epidermis and whitening - 2 publications, aesthetics and whitening - 92 publications, rejuvenation and LED light - 3 publications, epidermis and LED light - 7 publications, aesthetics and LED light - 5 publications, of these, again filtering was used totaling 145 articles that were included after reading the abstract. After reading, articles that did not meet the inclusion criteria were excluded, obtaining at the end 05 articles that contemplate the proposal of the revision.

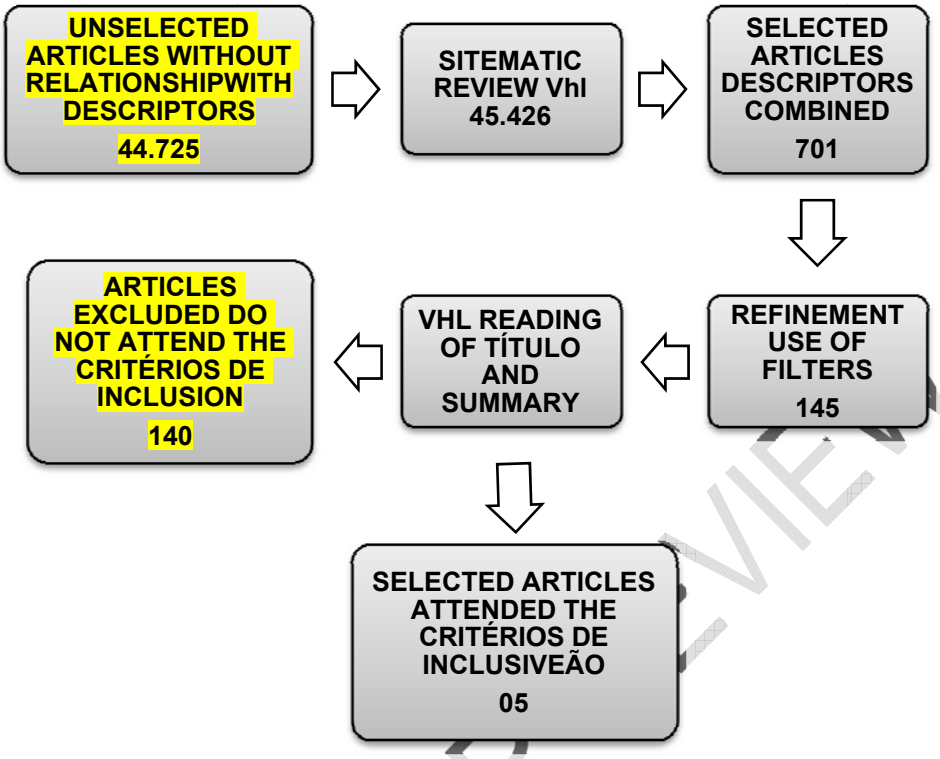

Figure 1: Flowchart

We analyzed 5 original articles that present similar objectives among themselves, seeking to understand the use of LED in the bleaching of hyperpigmentation of the epidermis, and its other beneficial effects on the skin, distributed in Figure 1.

3. RESULTS

Table 1: Analysis of publications

The main Autor	Year	Publication	Objective	Main Results
Culura et al	2014	View. Scientific of Unisalisian	Evaluate and describe the isolated and combined effects of treatment by means of phototherapy and electrolifting in static wrinkles.	There was no significant result using phototherapy and electrolifting in static wrinkles however, there were positive effects on

				epidermis bleaching.
Alves et al	2016	ASCES UNITA Repository	Analyze the efficacy of pharmacological actives and intervention with light-emitting diodes (LED) in the treatment of periorbital hyperpigmentation.	It was observed that group I that underwent acid therapy presented better results when analyzed about the width and area of extension of periorbital hyperpigmentation. While group II, which was subjected to the use of LEDs, showed better results regarding the width of periorbital hyperpigmentation.
Santos	2016	UNISC Institutional Repository	Evaluate in vivo the efficacy of the use of blue LED associated with the peeling of pyruvic acid and lactic acid in the cabin.	Improvement in skin appearance, greater homogeneity, and whitening of spots was observed through photographic evaluation, where a significant improvement can be observed ($p < 0.05$).
Rodrigues et al	2017	View. Scientific of Unisalisian	Compare the effects of phototherapy using blue LED and zinc and selenium trace elements in the treatment of facial melasma when associated and individualized.	The hypothesis that the association of blue LED with trace elements showed higher results in facial melasma compared to individualized resources was

				not proven.
Ferreira et al The main Autor	2017	View. Scientific of Unisalisian	Verify the efficacy of Phototherapy associated with Orthomolecular Therapy in the treatment of Periorbital Hyperpigmentation, and evaluate the results of individualized treatment and or when associated.	There was no result in the study in which it was hypothesized that the association of techniques with procedures performed individually showed better results in the bleaching of periorbital hyperpigmentation.

Table 2: Comparison of samples

AUTHOR	DIVISION OF GROUPS	FREQUENCY OF SESSIONS	PROTOCOL
CULURA et al, 2014	Three groups: LED phototherapy group(G1), Electrolifting Group(G2), Combined therapy group phototherapy and electrolifting (G3).	10 sessions, 2 weekly sessions.	G1 was exposed to red LED light for 7 minutes. G2 used micro galvanic current for 20 minutes (standardized time). G3 micro galvanic current for 20 minutes Then was exposed to the red LED light for 7 minutes.
ALVES et al, 2016	Group 1 cosmetic with the active ingredients, Group 2 was applied the blue LED, Group 3, the cosmetic was	10 sessions, 2 weekly sessions.	G1 cosmetic was applied with the active ingredients: thioglycolic acid 2%, tranexamic acid 5%, desonide 0.1%, on a gel basis. G2 blue LED was applied twice a week, G3 cosmetic was applied

	applied with the active ingredients associated with the intervention with blue LED.		with the active ingredients: thioglycolic acid 2%, tranexamic acid 5%, desonide 0.1%; being used once a day in the night shift for 30 days, associated with intervention with blue LED.
SANTOS, 2016	Only one group of 3 volunteers who received chemical peeling applications associated with LED in the cabin for the treatment of melasma.	4 sessions fortnightly.	The skin was sanitized, and then the blue LED device (Hygialux, KLD) was positioned and for 10 minutes it was irradiated across the face with the patient, after the application of acids starting with pyruvic acid at 50%, waiting 10 minutes and removing with water. Then, the lactic acid peeling was applied to 92%, with removal after 10 minutes and the irradiation of the blue LED for another 5 minutes.
RODRIGUES et al, 2017	15 volunteers, Blue LED Group, Oligoelements Group, and Blue LED Group and Trace elements.	3 weekly sessions.	Blue LED Group: face hygiene, exfoliation, spot application of blue LED for 1 minute with a dose of 8 joules, toning. Oligoelements Group: face hygiene, exfoliation, application of zinc and selenium trace elements, toning. Blue LED group and trace elements: face hygiene, exfoliation, spot application of blue LED for 1 minute with a dose of 8 joules, application of zinc and selenium trace elements, toning, all groups finished with sunscreen SPF 30.
FERREIRA et al, 2017	Phototherapy and Orthomolecular Therapy Group, Phototherapy Group, Orthomolecular Therapy Group.	2 weekly sessions for the three groups, totaling 15 sessions.	Phototherapy group and Orthomolecular Therapy: Hygiene; Physical abrasion; Application of the blue LED for 1 minute with a dose of 8 Joules; Application of infrared LASER to 2 joules; Toning; Trace elements (Zinc and Iron); Sun protection. b) Phototherapy group: Hygiene; Physical abrasion; Blue LED for 1 minute with a dose of 8 joules; 2 joules infrared LASER; Toning; Sun protection. Orthomolecular therapy group: Hygiene; Physical abrasion; Toning; trace elements (Zinc and Iron)

4. DISCUSSION

Among the 05 articles selected, it is observed that there is a consensus regarding the positive effects of LED light on the hyperpigmentation of the epidermis, most of the other articles showed improvement only in other aspects such as hydration, viço, skin quality, rejuvenation, but did not obtain significant results about the improvement of hyperpigmentation.

According to the study [9] found the isolated and combined effects of techniques with LEDtherapy and electrolifting in static wrinkles, where nine female volunteers aged 45 to 55 years and randomized into three groups, Phototherapy Group (GF), Electrolifting Group (EG) and Combined Therapy Group (GTC) participated and evaluated by means of anamnesis, in addition to visual, tactile evaluation and photographic record before and after treatment.

Subsequently, ten sessions were held for each group with a frequency of two weekly sessions and three-day intervals between one and the other. It was observed that in none of the techniques there was a significant improvement in wrinkles, on the other hand, there were changes in hydration and tissue bleaching in the phototherapy and combination therapy groups. It was concluded that there was no significant result using phototherapy and electrolifting in static wrinkles however, there were positive effects on epidermis bleaching.

In the study by [10]. The efficacy of pharmacological actives in intervention with light-emitting diodes (LED) in the treatment of periorbital hyperpigmentation was analyzed. Three groups of women with periorbital hyperpigmentation were selected for the study. In the results referring to the area of extension of periorbital hyperpigmentation, before and after the proposed treatment in each group, it was verified that there was a statistically significant difference in all groups; emphasizing that group 02, which was the group submitted to association with the LED obtained a reduction in the extension of ±6,9cm² passing to ±2,2cm² already the length before treatment was ±1,8 cm passing to ±1cm and the width was ±3,9 cm from ±2,5 cm after treatment. After a comparative analysis, it was observed that group I that underwent acid therapy presented better results when analyzed about the width and area of extension of periorbital hyperpigmentation. While group II, which was subjected to the use of LEDs, showed better results regarding the width of periorbital hyperpigmentation.

During the study by [11] The efficacy of the use of blue LED associated with pyruvic acid and lactic acid peelings for cabin melasma treatment, with fortnightly applications for eight weeks, 03 volunteers who received the cabin protocol with the application sequence of the blue LED, 50% pyruvic acid, application of lactic acid 92% were chosen, ending with the application of blue LED again and application of the solar filter.

In the results obtained in the study by [11], through photographic records and MASI index, as well as the evaluation of the quality of life of patients with the MelasQol questionnaire, it was observed the improvement in the skin aspect, greater homogeneity, and whitening of the spots through photographic evaluation, where a significant improvement can be observed ($p < 0,05$) only in one of the volunteers in the evaluation by the MASI proving the decrease in the severity of melasma. This study also points out that the association of blue LED with acid peels did not present adverse effects, showing that this association makes the treatment very tolerable.

Other studies such as [12] and [13] indicate that there was no efficacy in the treatment of epidermis bleaching using LED light associated with other techniques.

The study by [12] consisted of comparing the effect of phototherapy using blue LED and zinc and selenium trace elements in the treatment of facial melasma when associated and individualized, the proposed treatment aimed to provide bleaching and improve the appearance of melasma. It was expected that the association of phototherapy by means of blue LED with zinc and selenium trace elements in the treatment of facial melasma would be

more effective when compared to the use of individualized resources since phototherapy promotes the bleaching effect and antioxidant trace elements reduce the action of free radicals that are related to facial melasma. However, at the end of the treatment, the hypothesis that the association of blue LED with trace elements would present higher results in facial melasma was not proven compared to individualized resources.
And in the study by [13] the objective was to verify the effects of blue LED and infrared laser associated with zinc and iron trace elements on the bleaching of periorbital hyperpigmentation. Fifteen female volunteers with phototypes I and II were selected, thirteen sessions were performed with a frequency of two weekly sessions. It was concluded that there was no result in the study in which it was hypothesized that the association of techniques with the procedures performed individually denote better results in the bleaching of periorbital hyperpigmentation.

5. CONCLUSION

Given the studies, it can be concluded that LED light is an effective option not only in the bleaching of epidermis hyperpigmentation but also in other aspects such as hydration, rejuvenation, viço, and skin quality.
It is not pointed out that few publications address the effects of LED light on the hyperpigmentation of the epidermis and there is a need for more exploratory studies to be conducted to elucidate more about this subject.

COMPETING INTERESTS DISCLAIMER:

Authors have declared that no competing interests exist. The products used for this research are commonly and predominantly use products in our area of research and country. There is absolutely no conflict of interest between the authors and producers of the products because we do not intend to use these products as an avenue for any litigation but for the advancement of knowledge. Also, the research was not funded by the producing company rather it was funded by personal efforts of the authors.

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