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Comparison of the Conventional Lighting Technique versus the Lighting Activated by Light Sources



Thais Mazola Cardoso¹, Gabriel Gomes da Silva², Agenor Francisco Ribeiro Neto², Luiz Gustavo Xavier Filho², Daniel Felipe Fernandes Paiva², Luana Amorim Moraes da Silva², Lucas Cavalcante de Sousa², Amanda de Medeiros Amancio², Dennys Ramon de Melo Fernandes Almeida², Juliana Campos Pinheiro*², Amanda Feitoza da Silva³, Ana Paula Araújo Teixeira¹, Fellipe Moraes Pereira Figueiredo¹

¹Dentistry Course, Faculdade Maria Milza, Governador Mangabeira, Bahia, Brazil.

²Dentistry Course, Federal University of Rio Grande do Norte, Natal, Rio Grande do Norte, Brazil.

³Dentistry Course, Universidade Tiradentes, Aracaju, Brazil.

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ABSTRACT

Tooth whitening is a technique used to achieve dental aesthetics. This technique can be associated with the use of light sources to enhance bleaching. Therefore, in view of the above, the objective of this study is to review the scientific evidence in the literature regarding the use of light during bleaching in the bleaching effect compared to the conventional bleaching technique. Searches for articles were carried out in the electronic databases PubMed, PMC, Scielo and BVS, using the descriptors “agents tooth bleaching”; “Esthetic dental”; “Tooth bleaching” and 15 studies published from 2014 to 2019 were included. In the results obtained, it was observed that regardless of the technique used (with and without light association) the results were similar. Regarding dental sensitivity and microhardness of the substrate, it was found that both techniques contributed to the increase in postoperative sensitivity and enamel surface roughness. It was concluded that the use of light in the whitening process causes reversible and irreversible processes to the dental element, being also observed to a lesser extent during the conventional technique. In this way, the accelerating benefit of the light source in tooth whitening does not overcome the adverse factors related to its use.

INTRODUCTION

Aesthetic parameters have always guided society, being most of the time correlated with self-esteem and well-being, in addition to being determinants for social interactions¹. In this sense, cosmetic dentistry has aroused the interest of patients who wish to achieve a harmonic smile, where the balance between shape, texture, color and alignment of teeth with gingival tissues and lips is sought^{2,3}.

Within the modalities of treatments for the return of aesthetics to vital and non-vital teeth, whitening can be considered a conservative technique, as it provides the integrity of dental tissues, making it an attractive means for those who want to have their teeth more banks^{4,5}. The whitening treatment consists of the application of agents based on hydrogen peroxide on the buccal surface of pigmented teeth, its mechanism of action being related to the dissociation of this peroxide, and their action on the pigment macromolecules, reducing them in smaller chains^{6,7}.

The whitening techniques for vital teeth can be performed in an office with or without a light source, as well as through self-application by the home protocol with dentist supervision or through products classified as assisted or over-the-counter - OTC) - like whitening tapes, toothpastes and mouthwashes. For devitalized teeth, the whitening is done through the use of an oxidative agent, with or without the use of a light source⁸.

In the field of cosmetic dentistry, tooth whitening has always been at the top of clinical discussions, and the literature on this subject, in turn, presents a range of publications that have proposed to present the best means to guarantee a more satisfactory result³. In this context, the study aims to conduct a literature review about the scientific evidence, regarding the use of light during bleaching in the bleaching effect compared to the conventional office technique.

MATERIALS AND METHODS

The bibliographic study was carried out in the electronic libraries Scientific Electronic Library on Line SciELO (SciELO), Virtual Health Library (VHL) and PubMed and in the National Library of American Medicine (PMC) using the descriptors “agents tooth bleaching”; “Esthetic dental”; Tooth bleaching. Obtaining the period from 2014 to 2019 as a time frame. Experimental studies, laboratory research, case study and control, clinical and

randomized trials that evaluated the use of light in combination with whitening treatment were selected. Studies that made the association between in-office whitening techniques and home whitening were excluded.

RESULTS AND DISCUSSION

After the search, the stage of election of the works that would be included in the final sample proceeded from which 15 articles were extracted (Table 1). Of these, 8 comparative clinical studies, 5 randomized, 2 in vitro and only 1 experimental study (4 randomized, 1 in situ, 3 in vitro, 7 experimental). All studies compared the clinical results of in-office whitening with and without exposure to light sources.

Table No. 1: Characteristics of the articles selected for the study.

Article number	Author/year	Objective
1	Gallanari (2019) ⁹	Analyze the bleaching efficiency with or without LED light, using different clinical bleaching protocols and different concentrations of hydrogen peroxide.
2	Loiola (2016) ¹⁰	Evaluate the bleaching result using 15% and 35% hydrogen peroxide with and without association with the LED/laser.
3	Gonçalves (2016) ¹¹	To evaluate tooth whitening with and without LED/laser association and the influence on pulp responses.
4	Freitas (2016) ⁴	Evaluate the effects of using LED / Laser during tooth whitening with 35% hydrogen peroxide in the face of temperature variations, whitening effect and tooth sensitivity.
5	Mena-Serrano (2016) ¹²	To evaluate the effectiveness of office whitening using different concentrations of hydrogen peroxide (20% and 35%) with and without the association of the LED/laser.
6	Kiomars (2016) ¹³	To evaluate the efficiency of tooth whitening using different concentrations of hydrogen peroxide (30% and 46%) with and without activation of different wavelengths of diode laser.
7	Vieira (2018) ¹⁴	Analyze and compare the degree and speed of bleaching in bovine teeth, using 35% hydrogen peroxide with the influence of different types of light source (LED / blue light, LED/violet light) and without irradiation.
8	Loung (2018) ¹⁵	Evaluate the effect of different light sources on tooth whitening associated with 30% hydrogen peroxide.
9	Klaric (2014) ¹⁶	Observar a eficiência de diferentes fontes luminosas em relação ao branqueamento.
10	Lagori (2014) ¹⁷	Compare the <i>in vitro</i> effect of whitening using lasers of different lengths.
11	Know (2015) ¹⁸	Evaluate the effect of light on tooth whitening in relation to artificial dye.

12	Brugnera (2019) ¹⁹	Evaluate the lightening effect using 35% carbamide peroxide with and without associated with violet light emitting diode.
14	Shahabi (2018) ²⁰	Evaluate the change in tooth color after the dental whitening procedure in the office, with and without light activation (LED or KTP laser, diode laser, ND: YAG laser, CO2 laser).
15	Parreiras (2014) ²¹	Evaluate the effects of tooth whitening with and without LED activation for permeability, microhardness and mineral content of the dental substrate.
16	Anaraki (2014) ²²	To analyze the effect of laser tooth whitening on enamel roughness.

Source: Research data (2019).

Table 2 shows all the works found, which state that regardless of whether a light source is used to enhance the bleaching results, the final bleaching response will always be similar.

Table No. 2: Similarity of bleaching with and without exposure to light sources.

Sr. No.	Agente clareador e fonte de luz	Amostra/Resultado
1	Hydrogen peroxide 35% and 17.5% associated with LED.	It used 90 dental blocks. The bleaching agent 35% independent of the association with light source showed similar results.
2	Hydrogen peroxide at 15% and 35%. LED/laser.	44 bovine enamel plates. All the techniques used obtained the same bleaching results.
3	35% hydrogen peroxide. LED/laser.	96 bovine enamel/dentine central incisor discs. The study demonstrated that different protocols during bleaching with and without the association of LED/laser) did not influence the color change.
4	35% hydrogen peroxide. LED/laser.	26 patients. The use of light during tooth whitening does not influence the whitening result, compared to the conventional technique.
5	20% and 35% hydrogen peroxide. LED/laser.	77 patients. All techniques showed the same level of lightening (with and without LED/laser association).
6	Hydrogen peroxide (30% and 46%). Diode laser.	40 human premolars. All the techniques used by the study obtained the same results.

Source: Research data (2019).

These results were also found in the study by Marran (2019)²³ that through a systematic review of the literature, he observed that different concentrations of hydrogen peroxide, as well as different light sources (halogen light, laser, led, metal iodide light and PAC), do not

increase the effect of tooth whitening. Table 3, in turn, presents the studies that prove the superiority of the whitening effects, when a light source is added to the whitening technique in the office.

Table No. 3: Lightening efficiency when using light sources.

Sr. No.	Lightening agent and light source	Sample / Result
1	35% hydrogen peroxide. LED / blue light, LED / violet light.	The violet LED light enhanced the bleaching agent in relation to all the techniques used in the study.
2	30% hydrogen peroxide. LED.	Paper stained with hematoporphin. Regardless of the wavelength used for the protocol, it obtained the best results in relation to those that did not use light.
3	Carbamide peroxide: 10%, 16%, 30%. Hydrogen peroxide: and 25% and 38%. LED405, OLED and femtosecond laser.	50 hydroxylapatite tablets. The best bleaching results were present in the group that used LED405, regardless of the bleaching agent.
4	30% hydrogen peroxide. Laser.	120 bottles containing dye called rhodamine. The whitening results in the groups that were associated with the laser stood out in relation to those that did not use.
5	25% hydrogen peroxide. Light emitting diode.	160 third human molars. The results obtained demonstrated that the group that received the light source obtained significant results in relation to the group that did not receive the light source.
6	35% carbamide peroxide. Violet LED light.	50 patients. The change in tooth color was greater in the group that used the LED compared to the group that did not use it.
7	Hydrogen peroxide (15% and 35%). LED / laser.	40 patients. The best results were observed in the group that used 15% hydrogen peroxide with the LED/laser light source, compared to the group that used the highest concentration of 35% hydrogen peroxide without light activation.
8	40% hydrogen peroxide. LED or KTP laser, diode laser, ND: YAG laser, CO2 laser.	60 human anterior teeth. The technique that used the KTP laser proved to be more efficient.

Source: Research data (2019).

However, according to Gonçalves (2016)¹¹, studies related to the use of whitening light should not be limited only to the shade of the substrate after the procedure, as in the adverse

effects that association with light can generate. The authors state that the significant results with exposure to light are given by the initial dehydration of the tooth.

One of the consequences discussed in the literature on the use of light during whitening was in relation to dental sensitivity and damage to the pulp, in relation to the increase in pulp temperature (Table 4). Despite being a complication raised by the works, Freitas (2016)⁴ e Farhat et al. (2014)²⁴ revelam que independente da técnica utilizada, sempre haverá a presença da sensibilidade dental. Os nossos resultados corroboram com esses autores, demonstrando que não há superioridade sobre a presença de sensibilidade quando utilizada fontes ativadoras.

Table No. 4: Content manifested in relation to tooth sensitivity related to the association or not of the light source.

Sr. No.	Lightening agent and light source	Sample / Result
1	35% hydrogen peroxide. LED / laser.	26 patients. There were no significant results in dental senility, regardless of the association of light.
2	20% and 35% hydrogen peroxide. LED/laser.	77 patients. No significant results were observed for dental sensitivity regardless of the technique used.
3	35% carbamide peroxide. Violet LED light.	50 patients. Dental sensitivity in two patients in the group that used the LED in the office whitening.
4	Hydrogen peroxide (15% and 35%). LED / laser.	40 patients. Lower occurrence of tooth sensitivity in the group that used the LED/laser compared to the group that used the highest concentration of 35% hydrogen peroxide without light association.

Source: Research data (2019).

Another important factor presented by the studies as harmful to the use of light sources is the increase in variations in the pulp temperature (Table 5).

Table No. 5: Manifest contents about the variation of the intrapulp temperature with the association of the light source.

Sr. No.	Lightening agent and light source	Sample / Result
1	Hydrogen peroxide 35% and 17.5% associated with LED.	90 dental blocks. The largest variations in pulp temperature related to the use of a light source were observed, even causing damage to pulp cells.
2	35% hydrogen peroxide. LED/laser.	26 patients. The experimental group showed an increase in the temperature variation during the laser / led emission in relation to the technique that did not expose the light.

Source: Research data (2019).

The results found demonstrate an increase in the intrapulpal temperature variation when lightening was associated with light. Understanding that the pulp structure is the organ that shows the vitality of the dental element, it is necessary to know dentists in relation to all pulp risks that a given technique can present, especially when it comes to raising the temperature, direct relationship with the occurrence of pulp necrosis.

Regarding the selected studies that evaluated changes in the dental substrate after bleaching associated with light (Table 6), it was observed that regardless of the technique used (with or without light exposure), there was an increase in the superficial enamel roughness and substrate permeability.

Table No. 6: Characteristics of the articles analyzed on changes in the dental substrate after bleaching with and without exposure to light sources.

Sr. No.	Lightening agent and light source	Sample / Result
1	35% hydrogen peroxide associated with LED/laser.	50 human premolars. It is observed that regardless of the technique used, there was no increase in the permeability of the substrate, nor a reduction in the mineral content of tooth enamel.
2	40% hydrogen peroxide associated with laser.	15 human teeth. The results obtained show that the two techniques used increase the enamel surface roughness, and the teeth that did not use the diode laser presented higher numbers in relation to those that used laser.

Source: Research data (2019).

According to Parreiras (2014)²¹ and Anaraki (2014)²² the presence of roughness and porosity of the dental substrate after whitening may be associated with the acidic pH of hydrogen peroxide. In their studies, they proved that the techniques have been shown to increase dental permeability. One of the consequences discussed by Anaraki (2014)²² by the increase in the roughness of the dental enamel, it is the decrease of the resistance of the enamel, and even the biggest accumulation of bacterial plaque. For this reason, the author recommends the use of floured toothpastes in order to improve the characteristics of tooth enamel.

CONCLUSION

From the bibliographical survey, it was observed that the use of light sources can accelerate the mechanism of action of the bleaching gels, interfering in the immediate response of the bleaching when compared to the conventional technique. Scientific evidence also points out that the use of light in the whitening process causes reversible and irreversible processes to the dental element, being also observed to a lesser extent during the conventional technique. In this way, the accelerating benefit of the light source in tooth whitening does not overcome the adverse factors related to its use.

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