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REVIEW ARTICLE

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Vital laser-activated teeth bleaching and postoperative sensitivity: A systematic review

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Abstract

Objective: This systematic review investigated the effect of vital laser-activated tooth bleaching regarding efficiency and postoperative sensitivity. The search for articles was conducted on Medline (PubMed) database. The following keywords were used: "Lasers" [Mesh] and "Tooth bleaching" [Mesh]. Using the Boolean operator "AND," the following Boolean equation was formulated: ("Lasers" [MeSH] AND "Tooth bleaching" [MeSH]).

Materials and Methods: Inclusion criteria were as follow: clinical trials in English or French available in full text. Article search was limited to the ones published between 2007 and 2019.

Results: A total of 12 articles fulfilled the inclusion criteria. The quality assessment of trials included was undertaken independently as part of data extraction process. A JADAD score was attributed to each paper.

Conclusion: A marked color change was noted for patients undergoing light-activated bleaching independently of the bleaching agent. Regarding sensitivity, the results of the various studies proved controversial.

Clinical Significance: Laser activation of the bleaching agent promotes the efficiency of the treatment but does not reduce postoperative sensitivity.

KEYWORDS

dentin sensitivity, efficiency, lasers, systematic review [publication type], tooth bleaching

1 | INTRODUCTION

Bleaching is one of the most frequently prescribed procedures in esthetic dentistry which can have a great impact on the appearance of the teeth by removing extrinsic and intrinsic stains. The alteration of the three-dimensional structure of the pigmented molecules is at the origin of the external bleaching of a dyschromated tooth. The result is usually obtained through the action of a strong oxidizing agent.[1] Indeed, reactive oxygen derivatives produced by the bleaching agent diffuse easily into enamel and dentin.[2,3] These derivatives are responsible for the oxidation of dentinal chromogens. They react with the pigmented molecules of the hard tissues of the tooth, breaking them into shorter and therefore less colored molecules.[4] Several studies have shown that bleaching agents also penetrate the pulp thus generating a pulp inflammation causing tooth sensitivity, which is the most common adverse effect of bleaching.[5]

There have been several attempts to reduce tooth sensitivity associated with bleaching. Authors have proposed the application of products containing potassium nitrate and fluoride.[6,7] Others have used nonsteroidal anti-inflammatory drugs[8] or antioxidants such as ascorbic acid[9] but without satisfactory results. Others have tried to explore laser in bleaching techniques to improve efficiency and reduce sensitivity. The term Laser is the acronym for "Light Amplification by Stimulated Emission of Radiation."

In dentistry, laser was first used in 1964.[10] And ever since, it has revolutionized the practice of modern dentistry, with a growing interest in recent years. Studies on the contribution of laser tooth bleaching techniques are few and their results are controversial and sometimes contradictory. When different studies report inconsistent

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results, a systematic review and meta-analysis could clarify conflicting research data regarding specific issues.

The aim of this study was to determine the effectiveness of vital laser-activated external bleaching in controlling postoperative sensitivity using a systematic review of the literature.

2 | MATERIALS AND METHODS

The working group included four reviewers. The study required commitment on the part of the working group members, to a critical reading of articles, extracting and synthesizing data independently. Conclusions were eventually confirmed under a well-coordinated predefined grid. In case of disagreement, a discussion between the group members was necessary.

2.1 | Review question

The following well-defined review question was developed by using the population, intervention, comparison, and outcome criteria: does laser-activated bleaching compared to bleaching without activation or activated by other light sources (LED, halogen, plasma arc) result in higher efficacy and lower postoperative sensitivity? Hence, the key words for search strategy were "dental stain" as Population, "laser-activated bleaching" as Intervention, "bleaching without activation or activated by other light sources (LED, halogen, plasma arc)" as Comparison.

2.2 | Search strategy

The search for articles was conducted on Medline (PubMed) database. Indexing language based on terms from Medical Subject Headings (MeSH) was used. The following keywords were used: "Lasers" [Mesh] and "Tooth bleaching" [Mesh]. Using the Boolean operator "AND," the following Boolean equation was formulated: ("Lasers" [MeSH] AND "Tooth bleaching" [MeSH]). The search for this equation was stopped on 2nd January 2019. Hand searching was also performed on Pubmed.

2.3 | Study selection and data extraction

Article search was limited to the ones published between 2007 and 2019. The articles not published in French or English were excluded from the study. For the first screening, all papers were read in abstract. Two independent reviewers screened the titles and abstracts of all the identified studies to determine the relevant ones which met predetermined inclusion criteria. If there were insufficient data to make a clear decision, the full text was considered. Articles that had cited these studies were also identified through scholar google (http://www.scholar.google.com) to identify potentially relevant subsequent primary research. The two independent reviewers assessed the full texts of the relevant studies that eventually met the inclusion criteria proposed by the working group. Any disagreements were discussed and resolved by consulting a third reviewer.

Inclusion criteria were as follows: Clinical trials as article pattern; language: English, French; Studies available in full text.

TABLE 1 Rejected articles and reasons for exclusion

Articles	Reasons for exclusion
Koçak et al (2014)	This clinical study evaluated whether the use of a desensitizing agent (5% potassium nitrate/2% sodium fluoride) before in-office light-activated bleaching decreased this sensitivity
Martin et al (2013)	Paper available in abstract
Souza et al (2011)	This study assessed the effect of bleaching protocols with 38% hydrogen peroxide (HP) and post-bleaching times on shear bond strength of a composite resin to dentin
Reis et al (2011)	A study of a desensitizing gel effect on light-activated bleaching
Can-Karabulut et al (2010)	The purpose of the present study was to evaluate enamel bond strength of a composite resin material after bleaching
Patel et al (2008)	An in vitro study

Exclusion criteria were as follows: studies interested in nonvital teeth; studies that are not interested in the relationship between the laser and bleaching.

The relevant information found in the articles included in this study were extracted according to a predefined reading grid. This grid developed by the working group included details concerning: the article, population characteristics, laser characteristics, characteristics of the bleaching agent used, the evaluation mean of the bleaching, and the results observed.

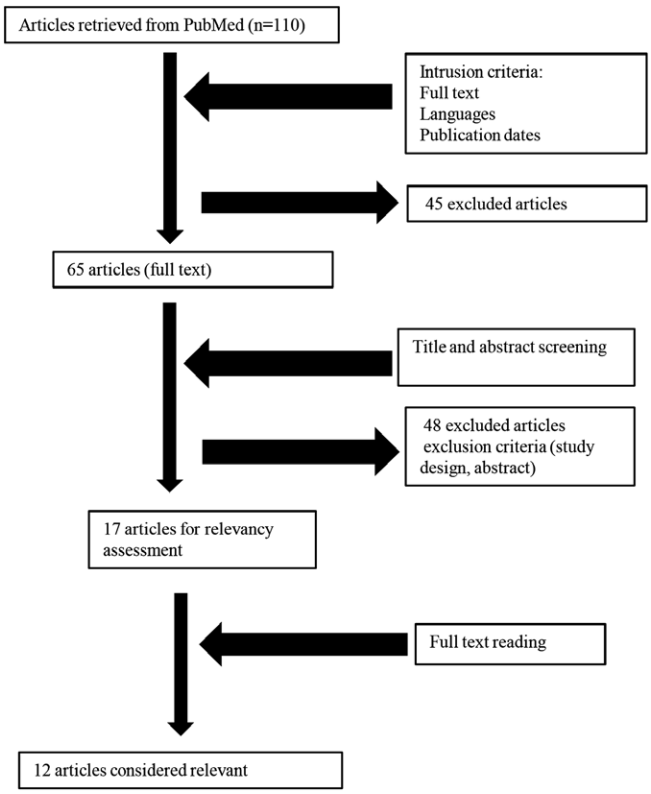

FIGURE 1 Flow chart of the search strategy

TABLE 2 Details of selected articles

Articles	Bleaching agent	Laser type	Searched effect	Follow-up
Vildosola et al (2017)	6% Hydrogen peroxide	LED/laser light	Effect on sensitivity and effectiveness of the bleaching	1 wk and 1 mo
Vildosola et al (2017)	6% Hydrogen peroxide 35% Hydrogen peroxide	LED blue/laser infrared activation system	Evaluation of the color longevity after a year	1 wk, 1 mo and 1 y
Moosavi et al (2016)	40% Hydrogen peroxide	LLRL * LLIL **	Effect on sensitivity and efficiency	No follow-up
Bortolatto et al (2014)	(a) 15% H_2O_2 containing TiO_N nanoparticles b) 35% H_2O_2	LED/LASER	Effect on sensitivity and efficiency	
Polydorou et al (2013)	38% Hydrogen peroxide	Diode laser	Color stability	3 mo
Martin et al (2013)	Hydrogen peroxide at 15%, 35%			
Moncada et al (2013)	(a) 15% H_2O_2 and nitrogenous-titaniumdioxide (b) 35% H_2O_2	Infrared laser diodes of 830 nm and 450 mW/cm^2	Tooth sensitivity determination	7 d
De Almeida et al (2012)	(a) 10% Carbamide pyroxide b) 35% Hydrogen peroxide	LED/infrared Laser	Occurrence, duration, and intensity of sensitivity	No follow-up
Mondelli et al (2012)	35% Hydrogen peroxide 38% Hydrogen peroxide 15% Carbamide peroxide	LED/Diode Laser, Whitening Lase II DMC Equipments, São Carlos, SP, Brazil	Color change, stability, and tooth sensitivity	After 24 h, 1 wk, 1, 6, 12, 18, and 24 mo
Kossatz et al (2011)	35% Hydrogen peroxide	LED/LASER	Efficiency Sensitivity	No follow-up
Gurgan et al (2010)	35% Hydrogen peroxide 37% Hydrogen peroxide 38% Hydrogen peroxide	Diode laser	Efficiency Side effects: sensitivity and gingival irritation	No follow-up
Wetter et al (2009)	38% Hydrogen peroxide 10% Carbamide peroxide	Diode laser	Difference of efficiency on Central incisors and canines	112 d
Marson et al (2008)	35% Hydrogen peroxide	LED/laser	Stability of color, sensitivity, and gingival irritation	6 mo

Abbreviations: LLIL, low level infrared laser; LLRL, low level red laser.

3 | RESULTS

3.1 | Description of studies

The search, arrested in January 2019, identified 110 publications, out of which 45 were excluded after application of date limitation. Forty eight publications were excluded after reviewing the title and abstract. Details of the excluded full text articles are given in Table 1.[7,11–15] Thus, a total of 12 articles fulfilled the inclusion criteria.[16–27] Figure 1 shows the search flowchart. All papers were controlled trials. The data extracted from selected articles were presented in summary tables for a better analysis (Tables 2–5).

3.2 | Quality assessment

The quality assessment of trials included was undertaken independently as part of data extraction process. A JADAD score was attributed to each paper (see Table 6). Other methodological criteria were examined. Clear inclusion/exclusion criteria were obtained for the eight papers.

3.3 | Interpretation of results

The color change was more marked for patients undergoing light-activated bleaching independently of the bleaching agent.[18–20] The LED/laser-activated bleaching was significantly efficient in the first session. After two sessions: both treatments showed a change of the tooth color without significant difference between them.[23]

The results of treatment efficacy differ from one assessment method to another.

By means of subjective evaluation, all the groups had an effective bleaching with a change of the hue without significant difference between them. By means of objective evaluation, the group whose bleaching is activated by the laser diode has a greater color change compared to the group whose bleaching is activated by LED or plasma arc.[25] A protocol using a low concentration of hydrogen peroxide (6%)

TABLE 3 Details of the population studied in each selected paper

Articles	Population				
	Population	Number of groups	Age and sex	Required color of the teeth before bleaching	Dental sector concerned by the treatment
Vildosola et al (2017)	30	2	Over 18 years old women: 14 men: 16	Two central incisors shade A2 or darker	A total of eight teeth between the second premolars
Vildosola et al (2017)	27	2	18 years old or older women: 10 men: 17	Both central incisors color A2 or darker	From the central incisor to the first premolar
Polydorou et al (2013)	60	3	Between 18 and 70 year old The sex distribution is not detailed	C2 or darker (maxillary canine)	Unspecified
Moncada et al (2013)	87	3	Between 18 and 37 y 64 female and 23 male	A maximum of TF3 fluorosis	Anterior teeth
De Almeida et al (2012)	40	4	Between 18 and 28 year old The sex distribution is not detailed	No color required	The two maxillas
Mondelli et al (2012)	48	5	18 to 30 years old The sex distribution is not detailed	A3 in at least four teeth	A split-mouth design was used, where the same patients were submitted to two bleaching treatments, one on the right superior and inferior arcs and the other in the left superior and inferior arcs
Kossatz et al (2011)	30	2	Between 18 and 25 year old The sex distribution is not detailed	C2 or darker (anterior teeth)	Unspecified
Gurgan et al (2010)	40	4	Between 18 and 30 year old women: 29 men: 11	A3 or darker (anterior teeth)	From premolar to premolar in both maxilla
Wetter et al (2009)	90	3	Between 18 and 45 year old women: 58 men: 32	No color required	From canine to canine in both maxilla
Marson et al (2008)	40	4	Between 18 and 28 year old The sex distribution is not detailed	No color required	Unspecified

catalyzed by hybrid light (LED/Laser) showed effective and stable color changes even 1 year after therapy compared with a conventional high concentration peroxide control (35%).[17]

Statistical analysis did not reveal any significant differences between in-office bleaching with or without hybrid light activation related to effectiveness; nevertheless the time required was less with hybrid light.[23]

Sensitivity lasted longer for the groups treated with hydrogen peroxide in comparison to those treated with carbamide peroxide, whether or not activated with laser.[22] Sensitivity was lower in the groups that adopted a laser diode-activated bleaching technique.[19,25] Low-level red laser treatment showed significantly lower sensitivity after 48 hours.[18,23] Activation with LED/Laser resulted in postoperative sensitivity in 53% of patients against 26% of patients treated without activation. The intensity of the sensitivity is greater in the group activated by the LED/Laser compared to the group without activation.[24] There were no differences in sensitivity noted for two protocols with or without infrared laser activation.[16]

Sensitivity and gingival irritation were lower in the group that adopted a laser diode-activated bleaching technique.[25] Sensitivity and gingival irritation were two side effects of the bleaching agent independently of the light activation (halogen lamp, LED, and LED/Laser).[27] Indeed, increases in the concentration of bleaching agents directly affect tooth sensitivity, and LED/laser activation and tooth thickness are not correlated with tooth sensitivity after dental bleaching.[21]

4 | DISCUSSION

A systematic review was found on Medline discussing the issue of bleaching activated by heat, light, or laser. This review was published in 2007.[28] The authors concluded that available studies, did not allow judging whether bleaching activation could improve or not the results of the treatment. Thus, an update of this review is needed to investigate the relationship between vital laser-activated tooth bleaching and improving effectiveness and postoperative sensitivity as well.

TABLE 4 Details of the bleaching technique considered in each article

	Bleaching technique						
Articles	Concentration of the agent	Application time	Number of applications	Number of sessions	Interval between sessions	Activation used	Total activation time (per session)
Vildosola et al (2017)	6% Hydrogen peroxide	Group A: 12 min Group B: 36 min	Group A: 3 Group B: 1	2	2 d	Group A: LED/laser light Group B: LED/laser light	Group A: 18 min Group B: 18 min
Vildosola et al (2017)	Experimental group: 6% hydrogen peroxide Control group: 35% hydrogen peroxide	12 min	2	3	1 wk	LED blue/laser infrared hybrid cold-light	24 min
Moosavi et al (2016)	40% Hydrogen peroxide	15 min	2	2	1 wk	Group 1: LLRL* Group 2: LLIL** Group 3: Placebo	15 s 15 s -
Bortolatto et al (2014)	G1: 15% H_2O_2 containing TiO_N nanoparticles G2: 35% H_2O_2	G1: 16 min G2: 15 min	G1: 3 G2: 3	G1: 3 G2: 3	G1: 1 wk G2: 1 wk	Group 1: LED/laser Group 2: no activation	G1: 48 min G2: -
Polydorou et al (2013)	38% Hydrogen peroxide	15 min	1	4	-	Group 1: no activation Group 2: halogen light Group 3: diode laser	- 8 min 30 s
Moncada et al (2013)	G1: 15% H_2O_2 + TiO_2 G2: 35% H_2O_2 G3: 35% H_2O_2	G1: 15-min alternating cycles of 1 min and 30 s G2: 10-min	G1: 3 G2: 3 G3: 45 min	1		G1: six LEDs as well as three infrared laser diodes G2: light activated (Lase Peroxide Sensy, DMC) G3: no activation	G1: five cycles of light activation per arch G2: Each application included 60% irradiation time
De Almeida, et al (2012)	G1: 10% Carbamide pyroxide Group 2, 3, and 4: 35% hydrogen peroxide					Group 1: no activation Group 2: no activation Group 3: Halogen light Group 4: LED/laser	- - 60 s 9 min
Mondelli et al (2012)	G1: 35% hydrogen peroxide (HP) + hybrid light HL (LED/Diode Laser); G2: 35% HP; G3: 38% HP (X-traBoost- Ultradent, South Jordan, Utah) + HL; G4: 38% HP; and G5: 15% carbamide peroxide	G1: 33 G2: 45′ G3: 33 G4: 45′ G5: 2 h/d	G1: 3 G3: 3		G5: 10 d	G1 and 3: Whitening Laser II (LED/therapeutic diode laser)	33′

(Continues)

TABLE 4 (Continued)

Articles	Bleaching technique							
	Concentration of the agent		Application time	Number of applications	Number of sessions	Interval between sessions	Activation used	Total activation time (per session)
Kossatz et al (2011)	35% Hydrogen peroxide		15 min	4	2	1 wk	Group 1: LED/laser Group 2: no activation	Group 1: 9 min Group 2: -
Gurgan et al (2010)	Group 1:	38% Hydrogen peroxide	15 min	2	1	-	No activation	-
	Group 2	37% Hydrogen peroxide	8 min	3	3	-	Diode laser	6 min
	Group 3	35% Hydrogen peroxide	20 min	3	1	-	Plasma lamp	21 min
	Group 4	38% Hydrogen peroxide	20 min	2	1	-	LED lamp	Unspecified
Wetter et al (2009)	Group 1	35% Hydrogen peroxide	20 min	1	1	-	Diode laser	30 s
		Carbamide peroxide 10%	1 h	7	No session: at home	-	No activation	-
	Group 2	35% Hydrogen peroxide	20 min	1	1	-	LED	3 min
				7	No session: at home	-	No activation	-
		10% Carbamide peroxide	1 h					
	Group 3	10% Carbamide peroxide	1 h	14	No session: at home	-	No activation	-
Marson et al (2008)	35% Hydrogen peroxide		15 min	3	2	1 wk	Group 1: no activation	-
							Group 2: Halogen light	Unspecified
							Group 3: LED	Unspecified
							Group 4: LED/Laser	Unspecified

Abbreviations: LLIL, low level infrared laser; LLRL, low level red laser.

TABLE 5 Characteristics of the laser used in each article

Study	Laser type	Wave length (nm)	Power (W)	Energy (J)	Energy density J/cm^2	Power density (MW/cm^2)	Total application
Vildosola et al (2017)	LED/laser light	Six LEDs: 470 ± 15 three infrared laser diodes: 810	Six LEDs: 1.8 three infrared laser diodes: 0,6	Unspecified	Unspecified	300	36 min
Vildosola et al (2017)	LED blue/laser infrared hybrid cold-light	LED blue: 450 ± 10 Laser infrared: 808 ± 10	LED blue: 1.5 Laser infrared: 0.3	Unspecified	Unspecified	Unspecified	72 min
Moosavi et al (2016)	LLRL (Thor DD2 control Unit, Thor)	660	0.2	3	12	800	15 s
	LLIL (Thor DD2 control Unit, Thor)	810	0.2	3	12	800	15 s
Bortolatto et al (2014)	LED/laser	LED: 470 ± 15 nm Laser: 808 nm	1.8 0.6	Unspecified	Unspecified	300	48 min
Polydorou et al (2013)	Laser diode (kavo dental GmbH)	980	6	Unspecified	Unspecified	Unspecified	2 min
Moncada et al (2013)	Infrared laser diodes	830 nm	Unspecified	Unspecified	Unspecified	450 mW/cm^2	45 min
De Almeida et al (2012)	LED/Laser (White lase II, DMC) composed of six LEDs — Blue light	470	Unspecified	Unspecified	Unspecified	Unspecified	9 min
	Three infrared diodes	808	0.2	Unspecified	Unspecified	Unspecified	Unspecified
Mondelli et al (2012)	Whitening Laser II (LED/therapeutic diode laser)	810 nm	-	-	-	200 mW/cm^2	33'
Kossatz et al (2011)	LED/Laser composed of three infrared diodes, laser whitening lase light plus, DMC	This light source is made of a matrix of LEDs with wavelength of 470 nm and three infrared laser diodes with 830 nm	Unspecified	Unspecified	Unspecified	200	Unspecified
Gurgan et al (2010)	Laser diode (LaserSmile)	815	0.01	Unspecified	Unspecified	Unspecified	45 s
Wetter et al (2009)	Laser diode	808	1	Unspecified	30	Unspecified	30 s
Marson et al (2008)	LED/Laser Biolux	470	Unspecified	Unspecified	Unspecified	Unspecified	Unspecified

Abbreviations: LLIL, low level infrared laser; LLRL, low level red laser.

Hence, the research was extended from 2007 to 2019 to determine the effectiveness and side effects of laser-activated procedures.

Different scientific databases exist (Cochrane, EMBASE, Web of Knowledge, BIOSIS Previews ...). MEDLINE remains a reference as a bibliographic database for clinicians. Many systematic reviews have been performed relying only on Pubmed search.[29]

In this systematic review, five articles studied the contribution of laser in the effectiveness of the treatment by exploring the three following parameters: speed of treatment, change of color in the short term, and stability of the treatment.

LED/laser-activated bleaching with 35%-hydrogen peroxide showed faster outcomes at one treatment session in comparison to ordinary 35%-hydrogen peroxide bleaching.[24] No difference in effectiveness was noted during the second session. The rapidity of bleaching for the group activated by the LED/Laser could be attributed to the dehydration of the tooth.

According to the study of Hein et al,[30] this dehydration is caused by the generation of heat provided by LED/Laser low intensity (200 W). Thus, this rapid color change could be described as desaturation rather than an effect of lighting itself.[31]

TABLE 6 Quality assessment

	Vildósola et al (2017)	Vildósola et al (2017)	Moosavi et al (2016)	Bortolatto et al (2014)	Polydorou et al (2013)	Moncada et al (2013)	De Almeida et al (2012)	Mondelli et al (2012)	Kossatz et al (2011)	Gurgan et al (2010)	Wetter et al (2009)	Marson et al (2008)
Randomization	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Method of randomization	Random drawing using Microsoft Excel 2010	Random drawing using Microsoft Excel 2010	A computer generated table of random numbers	Simple draw	Not mentioned	PASS software, version 2004	Not mentioned	Not mentioned	Coin toss	Not mentioned	Not mentioned	Not mentioned
Double blinding	Yes	Yes	Yes	Yes	No	No	No	No	Yes	No	No	No
Method of blinding	Appropriate	Not precised	Not precised	Not precised	No	No	No	No	Not precised	No	No	No
Dropouts/ withdrawals	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	No
Jadad score	5	4	4	4	1	3	2	2	4	2	2	1

This hypothesis is supported by other clinical studies postulating that light alone produces an initial change in color but does not persist for a long time. Similar conclusions are found in the studies of Kugel et al[32] and Tarvares et al[33] The lack of greater effectiveness in the second session is consistent with the conclusions of Marson et al,[27] who reported that more intense light sources had no effect on the speed of treatment.

Other studies found no change in color between LED/laser-activated bleaching with 35%-hydrogen peroxide and a similar treatment without activation.[24,27] Therefore, it can be said that the use of the laser did not contribute to a better efficiency. High concentrations of hydrogen peroxide used in the bleaching protocol may influence this result. Indeed, the amount of radicals produced by the chemical degradation of hydrogen peroxide is sufficient to react with the pigments, and a larger amount of free radicals will not improve the bleaching. Therefore, studies about lower concentrations are needed to elucidate such a hypothesis.

Similarly, Gurgan et al[25] reported that the use of a laser diode (810 nm) did not provide superior efficiency in comparison to other light sources. In the other hand, Polydorou et al[20] found that a 400/500 nm halogen-activated source bleaching has an efficiency greater than a diode laser (980 nm) both used with 38% hydrogen peroxide. This could be due to the difference in wavelength between the two light sources used (980 nm/400 nm). A 6-month treatment stability was reported in both studies.

Postoperative sensitivity, even transient, is a common side-effect occurring regardless of the bleaching technique and activation used.[18]

The use of laser decreased the postoperative sensitivity. Moosavi et al[18] focused on the use of low intensity laser therapy. According to their clinical trial, the low level infrared laser (LLIL) does not have an immediate effect in reducing sensitivity during bleaching (after 1 hour). On the other hand, it has a mediated effect which was observed during the 24 hours after bleaching, sensitivity decreased for the LLIL group compared to the other two groups using the low level red laser (LLRL) or without activation.

Sensitivity was significantly lower within 24 hours. After 48 hours of treatment, the use of both types of laser offered a lower sensitivity than the group without activation. Thus, the use of Low Intensity Laser Therapy can be considered as an effective strategy in reducing postoperative sensitivity, as it reaches its maximum after 24 hours. Irradiation with LLIL is preferable as this type of laser is more effective than the LLRL which showed a sensitivity reduction only after 48 hours.

The use of low-intensity laser can reduce cell damage and accelerate the inflammatory process caused by hydrogen peroxide in pulp tissues and even inhibit the passage of neurosensory impulses. This can be attributed to its analgesic and anti-inflammatory effects demonstrated by several studies.[6,20] The effectiveness is obtained a few hours after the application of the laser.

The difference between LLIL and LLRL can be explained by the difference in depth of penetration of the different wavelengths of the two types of laser. Indeed, the penetration capacity of red light (Red laser) is 8-10 mm, while that of infrared is 2-3 cm which can explain the greater efficiency of LLIL compared to the LLRL.

Although, other studies showed that a good result can be obtained only after repeated applications of the laser, our study proved that a single laser-activated bleaching session is sufficient to obtain a satisfactory result, with a reduction of postoperative sensitivity.

In 2010, Gurgan et al[25] had previously confirmed these results. The postoperative sensitivity is lower when using the laser diode (810 nm) than is the case with other activation procedures (plasma arc lamp [400/490 nm] and LED [400/500 nm]) or without activation. De Almeida et al[22] found no difference in the intensity of sensitivity when bleaching with 35% hydrogen peroxide activated by LED/Laser (470 nm) or by a halogen source (450/500 nm). This can be explained by the difference in wavelength of the two LED/Laser sources used in these two tests. De Almeida et al[22] concluded that the postoperative sensitivity felt by patients treated with laser-activated hydrogen peroxide is more intense than that felt by patients treated with carbamide peroxide alone. This can be explained by the high concentration of hydrogen peroxide which is 35%. Indeed, the 2008 study by Caviedes-Bucheli et al[34] showed that after an external lighting activated by LED/laser or other light source, there is penetration of the reactive oxygen in pulp. This leads to a synthesis of the P-substance, which is a neuropeptide whose functions are related to inflammation, whereas after home lighting with carbamide peroxide, there is little or no production of the P-substance. In addition, laser activation is not sufficient to decrease sensitivity in comparison with 10% carbamide peroxide bleaching.

De Almeida et al[22] also demonstrated that sensitivity lasted longer in patients treated with laser or halogen-activated hydrogen peroxide compared to those treated with carbamide peroxide.

This can be explained by the amount of hydrogen peroxide, which penetrates into the pulp. Indeed, after 15 minutes of the treatment, the penetration of the hydrogen peroxide in the pulp is 12 times higher when using hydrogen peroxide than when using the 10% carbamide peroxide according to Costa et al.[35]

5 | CONCLUSION

From this systematic review, it can be concluded that laser activation of the bleaching agent did not provide a better efficiency compared to the conventional method. Results were stable in time independently of the use of the laser. Regarding dental sensitivity, the results of the various studies are controversial. Some studies have reported that laser-activated bleaching reduces postoperative sensitivity, while others have concluded that laser may be the cause of increased sensitivity. Clinical significance: Laser activation of the bleaching agent promotes the efficiency of the treatment but does not reduce postoperative sensitivity.

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DISCLOSURE

The authors do not have any financial interest in the companies whose materials are included in this article.

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