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Dental bleaching in smokers: an integrative review

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Abstract

Objective: to carry out an integrative review of the literature on the indication of dental bleaching in smokers with the use of peroxides as a bleaching agent, related to safety of treatment, effectiveness, tooth sensitivity, its effect on tooth structure and longevity. Additionally, the effect of bleaching toothpaste on smoking patients was also searched. **Material and Methods:** research in PubMed, LILACS and Scopus databases were performed using the following keywords in association: (Bleaching OR whitening or dental bleaching) AND (smoke OR smoker OR cigarrete), in both English and Portuguese languages. The inclusion criteria were: articles published between 2008-2018, in vitro and clinical studies, and literature review. **Results:** 56 articles were found. After analysis by title, 20 articles were selected. After reading the abstracts, 6 articles were excluded. 14 articles were fully read, 6 were excluded according to the inclusion / exclusion criteria and 08 articles were addressed in this review. **Conclusion:** 10% carbamide peroxide is a safe method for dental bleaching in smokers. Peroxides at different concentrations were effective in dental bleaching. There was no significant difference between smokers and non-smokers in relation to sensitivity. Bleaching agents do not cause permanent changes in tooth structure. Regarding longevity, in one year there was a regression of color in smokers and non-smokers, and prophylaxis was efficient in the removal of extrinsic staining in smoking patients, stabilizing the color obtained in whitening. Bleaching toothpastes were not effective in removing stains.

Keywords: Tooth bleaching; Hydrogen peroxide; Smokers; Toothpastes.

Introduction

According to the World Health Organization, more than one billion people use tobacco around the world.[1] Although there has been a decline in tobacco consumption in recent decades, population growth causes the number of smokers to be high around the world.[2] In Brazil, a national questionnaire (Pesquisa Nacional por Amostras de Domicilio – PNAD) applied by the Brazilian Institute of Geography and Statistics (Instituto Brasileiro de Geografia e Estatística – IBGE), revealed that about 24.6 million Brazilians (18%) smoked tobacco. In 2013, the National Health Survey (Pesquisa Nacional de Saúde – PNS - IBGE) revealed a small reduction in the number of users of tobacco products considering 21.9 million (15%) of Brazilians over 18 years of age.[3] Thus, as seen worldwide, despite the reduction in the number of users, tobacco consumption is still high.

In addition to a wide variety of toxic chemicals, tobacco also contains coloring substances, such as tar, coffee, and nicotine,[4] which although it is a colorless substance, turns yellow when exposed to oxygen.[5] These substances have already been observed in composite resins and which may cause extrinsic and intrinsic discoloration of the teeth.[5] The prevalence of self-assessed dental yellowing in smokers is almost double comparing to that reported by non-smokers. Thus, smokers are probably the main candidates for whitening procedures.[6]

In cases of extrinsic stains, prophylaxis may be an adequate means of recovering the natural dental color, decreasing the amount of nicotine and other pigments. However, it must be considered that this darkening can also be caused by nicotine deposition within the dental structure. In case of intrinsic stains, it may be needed oxidizing methods, such as tooth bleaching, in order to alter the molecular structure of these pigments and recover the original dental color.[5]

The indication of bleaching for smoking patients is not well established yet, especially regarding the safety of this type of treatment, in which the patient is often advised to quit smoking during treatment, and the longevity of this treatment is still unknown. The objective of this study was to perform an integrative review of the literature on the indication of dental bleaching in smokers using peroxides as a bleaching agent in relation to the safety of treatment, effectiveness, presence of tooth sensitivity, its effect on tooth structure and the longevity of treatment. Besides, the effect of bleaching toothpastes on smoking patients was also searched.

Material and Methods

For the present integrative review, we used the databases PubMed (https://www.ncbi.nlm.nih.gov/pubmed/), LILACS (http://lilacs.bvsalud.org), and Scopus (https://www.scopus.com/search/form.uri?display=basic). The following keywords were used in association: (Bleaching OR whitening or dental bleaching) AND (smoke OR smoker OR cigarrete), in both English and Portuguese languages to detect all the articles related to this subject. The inclusion criteria considered articles published between 2008 and 2018, in vitro

studies, clinical studies and literature review. Articles that preceded 2008, in addition to those that did not address the objective of the study, were used as exclusion criteria.

Results

A total of 56 articles were found in the electronic search, being discarded the repeated articles. After title analysis, 20 papers were selected for abstracts readings. After reading the abstracts, 6 articles were excluded because they did not fit the subject. Then, a total of 14 articles were full-read. 6 out of 14 articles were excluded according to the inclusion / exclusion criteria of the present review. Thus, 08 articles were considered reliable for the present review, being 4 in vitro articles, 3 clinical studies and 1 literature review (Table 1).

Table 1. Chosen studies according to inclusion/exclusion criteria of the present review

Author	Study type	Bleaching type (whitening)	Study's aims	Main findings
de Geus *et al.*, 2018[5]	*In vitro*	In-office (35% Hydrogen peroxide)	To evaluate colour changes and to quantify nicotine in teeth exposed to cigarette smoke, after dental prophylaxis and after in-office bleaching.	There was considerable blackness after exposure to cigarette smoke. Dental prophylaxis was able to recover the original colour of the teeth. After bleaching, the teeth became whiter than in the initial analysis. Regarding the presence of nicotine in the dental structure, dental prophylaxis was able to remove approximately 36% of the nicotine present. In dental bleaching, an expressive reduction of approximately 75% was observed.
Públio *et al.*, 2013[7]	*In vitro*	In-office (35% Hydrogen peroxide)	To evaluate the influence of remineralizing agents, including artificial saliva, neutral fluoride and amorphous calcium phosphate casein phosphopeptide, on the susceptibility of bleached enamel to cigarette smoke pigmentation.	Post-bleaching treatment for remineralization of the enamel using neutral fluoride may contribute to increase the potential darkening of enamel due to cigarette smoke. The previous bleaching was effective.
Bazzi *et al.*, 2012[8]	*In vitro*	At-home (6% Hydrogen Peroxide)	To evaluate the effect of bleaching and brushing on the removal of smoke and coffee stains.	Bleaching removed both coffee stains and cigarette smoke while brushing, just the stains caused by cigarette smoke. A recolour with the cigarette smoke did not lead to further discoloration. Bleaching was effective.
Silva *et al.*, 2018[4]	*In vitro*	Toothpaste (Colgate Luminous White, Oral B 3D White). Composition: Abrasives	To evaluate the effect of tooth brushing with whitening toothpastes on the roughness and optical behaviour of bovine enamel submitted to cigarette smoke for eight weeks.	The three toothpastes were not able to remove the extrinsic stains. Likewise they did not maintain the natural optical stability of the enamel surfaces after eight weeks. The toothpastes increased the surface roughness of the enamel. The study suggests that this therapy may not be effective for smokers.
de Geus *et al.*, 2015[6]	Clinical trial	At-home (10% Carbamide Peroxide)	To evaluate the degree of dental sensitivity of smokers and non-smokers during bleaching; compare the effectiveness of bleaching after 1 week and 1 month.	There was no statistical difference regarding dental sensitivity between smokers and non-smokers during bleaching. Regarding the effectiveness of the bleaching treatment, there was no difference 1 week after the whitening has ended. However, after 1 month, smoking patients showed different enamel density values.
de Geus *et al.*, 2015[9]	Clinical trial	At-home (10% Carbamide Peroxide)	Evaluate colour longevity after one month and one year of bleaching in smokers and non-smokers.	Bleaching was effective for both groups, remaining stable in one month. In one year there was colour regression for both groups. Bleaching was stable in both groups after removal of extrinsic stains caused by diet and smoking with professional prophylaxis. The effect of dental prophylaxis was more effective in smokers.
de Geus *et al.*, 2015[10]	Clinical trial	At-home (10% Carbamide Peroxide)	To evaluate the effectiveness of whitening in smokers and non-smokers and the degree of sensitivity. To assess the genotoxicity potential of bleaching through micronucleus (MN) frequency in exfoliated epithelial cells.	Bleaching was effective in smokers. At one month the colour remained stable, with no significant differences between groups. During bleaching, the degree of sensitivity reported was similar for both groups. Bleaching did not increase MN frequency. The amount of MN was significantly higher in smokers than in non-smokers, regardless of whitening.
Navarrola *et al.*, 2015[11]	Literature Review		Emphasize, through scientific evidence, if the ingestion of drinks with pigments and the smoking habit, interfere in the dental whitening.	Dental bleaching is effective in removing stains caused by cigarette smoke, and does not cause permanent changes in the structure of the tooth enamel. Such stains appear to be superficial. Dental bleaching in combination with smoking is theoretically safe.

Of the articles studied, 2 were about the safety of bleaching treatment in smokers,[10,11] 07 articles about the effectiveness of bleaching,[5-11] 02 treated the longevity of treatment,[6,9] 03 analysed teeth sensitivity,[6,7,10] 02 considered enamel changes,[4,7] 01 related to the presence of nicotine in the interior and enamel surface[5] and 01 about the effect of bleaching toothpastes.[4]

Discussion

Patients seeking for dental bleaching as an aesthetic tool for a harmonic smile has become usual over the last decade.[12] Alkhatib *et al.*[13] found that smokers were more unhappy with their dental color when compared to non-smokers, showing the negative impact of smoking about dental aesthetics. In order to satisfy smoking patients with dental aesthetics and provide them means of bleaching treatment, the dental surgeon must have knowledge about the safety and effectiveness of this treatment, based on scientific evidence, and then to indicate or contraindicate the bleaching treatment for these patients.

This integrative review evaluated the scientific evidence found in the literature on dental bleaching in smokers in the last 10 years, addressing safety, bleaching effectiveness in smokers, treatment longevity compared to non-smokers, and the impact of nicotine and pigmentations caused by smoking in the tooth structure.

In 1998, Bonfim *et al.*[14] carried out a bibliographic survey on dental bleaching agents used for vital and non-vital teeth and possible adverse effects, concluding that patients smokers and consumers of alcoholic beverages should do total abstinence from the habit for, at least, few days before the beginning, during and until one day after the conclusion of the bleaching as a precaution. This indication was based on studies suggesting that peroxides could be enhancers of carcinogenic substances present in tobacco and alcoholic beverages. Based on these findings, in book chapters recently published in Brazil, the authors[15,16] contraindicate dental bleaching in smoking patients or suggest avoidance or reduction of smoking habit during bleaching due to carcinogenic potential. However, in the present review, Geus *et al.*[10] evaluated the genotoxicity potential of at-home bleaching through the frequency of micronuclei in exfoliated epithelial cells and observed that bleaching did not increase micronucleus frequency, showing that this technique did not induce DNA damage in gingival tissue during the 3-week treatment period, thus being considered a safe technique for smoking patients. Herein, Filho *et al.*, in a histological study, observed that 10% carbamide peroxide caused an increase in proliferative activity in the basal and parabasal layers of the gingival epithelium, resulting in a morphometry change of this tissue in both smoking and non-smoking patients. [17]

Munro *et al.* evaluated in a literature review bleaching products containing hydrogen peroxide or carbamide peroxide, related to the potential risk of oral cancer.[18] Clinical data on tooth bleaching containing hydrogen peroxide only showed evidence of mild and transient gingival irritation and tooth sensitivity, with no evidence of development of preneoplastic or neoplastic oral lesions. Exposures to hydrogen peroxide, including areas commonly associated with oral cancer, were extremely low and did not show a representative risk of promoting cell-initiation or inducing carcinogenic effects synergistically with cigarette smoke or alcohol. Still, the concentrations of hydrogen peroxide were higher in the gingiva, a site extremely rare for oral cancer. These findings corroborate with the studies of Navarrola *et al.*, [11] which consider in their literature review that dental bleaching combined to smoking is theoretically safe. There are no indicatives in the recent literature of a carcinogenic potential of bleaching agents, being considered a safe treatment. On the other hand, there are only few published articles properly assessing changes in the oral mucosa or at cellular level, and generally are short-term studies, insufficient data to find any evidence.

It is important to highlight that a detailed anamnesis is essential for the safety of treatment, providing information such as: the frequency of daily cigarette smoking and the existence of a previous history of cancer. Thus, it avoids the exposition of a high-risk patient to an unfavourable situation, thereby fulfilling our role as health promoters. To prevent bleaching agents from coming into contact with the gingival mucosa during in-office bleaching and causing mucosal irritation, the dentist can cover gingival tissue by using absolute isolation or liquid dental dams.[16] For patients with smoking habits and considered as high-risk, in-office bleaching would be a good option, since it allows a more effective protection to the soft tissues, due to the use of barriers and greater control by the dentist.

Concerning the effectiveness of bleaching, it is firstly necessary to understand how the dental structure discoloration occurs. Discoloration can be caused by stains due to nicotine deposition inside the tooth structure and external staining on the surface of the enamel.[5] The appearance of cigarette-induced stains is highly dependent on the time and frequency of smoking.[5] Smokers' teeth tend to develop tobacco stains that can range from yellow to black.[11] Most darkening is associated with extrinsic stains, since cigarette smoke is composed of macromolecular chains and thus is not easily able to permeate the human enamel, which allows the passage of molecules with only lower molecular weight.[6]

As it is mostly macromolecules present on the outer surface of the enamel, professional dental prophylaxis can remove most of the staining caused by nicotine on the surfaces of the teeth, showing an effective method to restore initial tooth structure *both in vitro*[5] and *in vivo*[9]. Also, Bazzi *et al.* [8]

verified in an in vitro study that simple brushing was effective in removing cigarette stains from the tooth structure because they were just extrinsic stains.

Although dental prophylaxis is an effective method for removal of extrinsic stains, bleaching may further reduce the internal and external coloration caused by nicotine.[5] Considering inner layers, only oxidizing methods, such as tooth bleaching, are able to alter the pigment molecular structure, breaking it and recovering the natural dental colour or even lightening it. This assumption is supported by data from Geus and colleagues who found that tooth bleaching led to a reduction of approximately 75% in nicotine while dental prophylaxis removed only 36% of the same substance present in the tooth structure.[6] Importantly, the study shows that though the nicotine was within the internal dental structure, it was not enough to change the teeth colour. Regarding efficacy, tooth bleaching was effective in whitening teeth of smoking patients, both in in vitro and in vivo studies.[5-11]

Regarding the longevity of the treatment, the literature shows controversial results. Geus *et al*., in 1 month of evaluation, observed that the tooth of smokers can return to pigmented coloration quicker than those of non-smokers.[6] However, the same group have found in other studies similar long-term effectiveness of 1 month and 1 year between smokers and non-smokers.[9,10] The differences observed in the studies may be associated to the selection of patients in the different studies.

It has been reported that the loss of mineral content during bleaching may cause decalcification, porosity and topographic changes, which could favour staining of the dental structure after exposure to pigments.[7,10] In 2013, Publio *et al.* evaluated the influence of pigment agents, such as cigarette smoke, enamel after dental bleaching and the use of remineralizing agents.[7] The authors verified that the microporosities formed after bleaching were not homogeneously remineralized with fluoride application, which allowed stains to develop on the enamel surface after exposure to cigarette smoke. Enamel exposed to artificial saliva for 30 minutes showed the lowest level of smoke staining.[7]

Sensitivity is a common side effect seen during tooth bleaching.[6] In the present review, in regard to dental sensitivity analyses, smokers and non-smokers presented similar results during and after bleaching, in which sensitivity was reported as mild.[6,10]

Whitening toothpastes, with different abrasives in their composition, have been indicated to remove or prevent the deposition of extrinsic stains on the dental surface. However, in this review, whitening toothpastes containing abrasives were not able to remove the extrinsic stains caused by smoking. The unfavourable results may be associated with the brands of the tested toothpaste, and the fact that it is an in vitro study, where fragments of bovine enamel were submitted only to smoke from a single cigarette brand.[4]

According to the findings of the present review, it was verified that dental bleaching seems safe for smoking patients, with effective results. Carbamide peroxide 10% in a recent study was proved to be safe, not causing damages to the tissues, being its indication feasible. Nevertheless, caution is required along this information due to few studies that have evaluated changes in oral mucosa or at the cellular level, even though further studies in a long-term way are needed to bring definitive evidences. Additionally, the literature lacks studies evaluating the safety of the use of hydrogen peroxide, in different concentrations, for at-home or in-office bleaching. Effective bleaching is achieved in smokers, either by the use of 10% carbamide peroxide,[6,9,10] 6% hydrogen peroxide for at-home use[8] and 35% hydrogen peroxide for in-office assisted use.[5,7] The colour obtained after bleaching in a long-term showed to regressing in smokers and non-smokers, thus dental prophylaxis proved to be effective to return to the initial colour in smokers.[5] Sensitivity to bleaching has not shown to be increased in smoker patients.[6,10] Although whitening toothpastes containing different abrasives in their composition are available in the Brazilian industry, the brands evaluated in the literature have not shown to be effective for whitening and removal of pigments in smokers.[4] Further studies are needed regarding the safety of hydrogen peroxide in different concentrations, for at-home and in-office use in smokers. Other clinical studies, with a more reliable sample design, evaluating a larger number of patients, in the long term, may give better information about the effect of bleaching in smoking patients, since considering longevity, it was observed that the sample size can influence on the results obtained.

Conclusion

According to the articles included in the present integrative review it was possible to conclude that 10% carbamide peroxide for at-home use seems to be a safe method, since such agents do not cause permanent changes in the structure of the dental enamel. Besides, peroxides for home and office uses were effective in dental bleaching. Regarding the postoperative sensitivity, there was no significant difference between smokers and non-smokers, and the use of fluoride as a desensitizer is not indicated because it may contribute to increase the potential for blackening of the enamel by cigarette smoke. About longevity, in one year there was a regression of colour in smokers and non-smokers patients. Dental prophylaxis was efficient in the removal of extrinsic stains in smoking patients, stabilizing the colour obtained by the bleaching agent.

Concerning the use of whitening toothpastes, they were not effective in removing stains, causing a change in the natural optical properties of the tooth enamel.

References

1. Organização Mundial de Saúde - World Health Organization. Tobacco [online]. [Accessed in July, 2018]. Available at http://www.who.int/en/news-room/fact-sheets/detail/tobacco
2. Ng M, Freeman MK, Fleming TD, Robinson M, Dwyer-Lindgren L, Thomson B, et al. Smoking prevalence and cigarette consumption in 187 countries, 1980-2012. JAMA. 2014;311(2):183-92.
3. Malta D, Vieira ML, Szwarcwald CL, Caixeta R, Brito SMF, dos Reis AAC. Tendência de fumantes na população Brasileira segundo a Pesquisa Nacional de Amostra de Domicílios 2008 e a Pesquisa Nacional de Saúde. 2013. Rev Bras Epidemiol. 2015;18(2):45-56.
04. Silva ME, Maia JNSMD, Mitruad CG, Russo JES, Poskus LT, Guimarães JGA. Can whitening toothpastes maintain the optical stability of enamel over time? J Appl Oral Sci. In press 2018;26:e20160460.
05. de Geus JL, Beltrame FL, Wang M, Avula B, Khan IA, Loguercio AD, et al. Determination of nicotine content in teeth submitted to prophylaxis and in-office bleaching by gas chromatography–mass spectrometry (GC-MS). Clin Oral Investig. 2018; 21. DOI: 10.1007/s00784-018-2388.
06. de Geus JL, Bersezio C, Urrutia J, Yamada T, Fenández E, Loguercio AD, et al. Effectiveness of and tooth sensitivity with at-home bleaching in smokers: A multicenter clinical trial. J Am Dent Assoc. 2015;146(4):233-40.
07. Públio JC, D'Arce MBF, Brunharo NM, Ambrosano GMB, Aguiar FHB, Lovaldino JR, et al. Influence of surface treatments on enamel susceptibility to staining by cigarette smoke. J Clin Exp Dent. 2013;5(4):e163-8.
08. Bazzi JZ, Bindo MJF, Rached RN, Mazur RF, Vieria S, Souza EM. The effect of at-home bleaching and toothbrushing on removal of coffee and cigarette smoke stains and color stability of enamel. J Am Dent Assoc. 2012;143(5):e1-7.
09. de Geus JL, Lara MB, Hanzen TA, Fernández E, Loguercio AD, Kossatz S, et al. One-year follow-up of at-home bleaching in smokers before and after dental prophylaxis. J Dent. 2015; 43(11):1346-51.
10. de Geus JL, Rezende M, Margraf LS, Bortoluzzi MC, Fernández E, Loguercio AD, et al. Evaluation of Genotoxicity and Efficacy of At-home Bleaching in Smokers: A Single-blind Controlled Clinical Trial. Oper Dent. 2015;40(2):E47-55.
11. Navarrola EDA, Riverala KVF, Cotrina LD, Chu Jon LYT. Resolviendo mitos sobre indicaciones al paciente durante el blanqueamiento dental. Rev Estomatol Herediana. 2015; 25(3):232-7.
12. Oliveira JAG, Cunha VPP, Farjado RS, Rezende MCRA. Clareamento dentário x autoestima x autoimagem Dental. Arch Health Invest. 2014;3(2):21-5.
13. Alkhatib MN, Holt RD, Bedi R, Smoking and tooth discolouration: findings from a national cross-sectional study, BMC Public Health. 2005;24;5:27.
14. Bonfim MDC. Efeitos deletéricos dos agentes clareadores em dentes vitais e não vitais. JBC, 1998;2(9):25-32.
15. Dias ARC. DiasKRHC. Corrêa Netto LR. Brasil SC. Clareamento de dentes desvitalizados. In: Associação Brasileira de Odontologia; Pinto T, Pereira Jc, Masioli MA, organizadores. PRO-ODONTO ESTÉTICA Programa de atualização em Odontologia Estética: Ciclo 9. Porto Alegre: Artmed Panamericana; 2015. P. 43-91.
16. Conceição EN, et al. Dentística: saúde e estética. 2nd ed. Porto Alegre (BR): Artmed; 2007. 583 p.
17. Filho LC, Costa CC, Sória ML, Taga R. Effect of home bleaching and smoking on marginal gingival epithelium proliferation: a histologic study in women. J Oral Pathol Med. 2002;31:473-80.
18. Munro IC, Williams GM, Heymann HO, Kroes R. Tooth whitening products and the risk of oral cancer. Food Chem toxicol. 2006;44(3):301-15.

Mini Curriculum and Author's Contribution

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