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Review

Evaluation of the efficacy of potassium nitrate and sodium fluoride as desensitizing agents during tooth bleaching treatment—A systematic review and meta-analysis

Yining Wang [a,1], Jinxia Gao [a,1], Tao Jiang [a], Shanshan Liang [a], Yi Zhou [a,*], Bruce A. Matis [b]

[a] Department of Prosthodontics, School and Hospital of Stomatology, Wuhan University, Wuhan, PR China
[b] Indiana University School of Dentistry, Indianapolis, IN, USA

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ABSTRACT

Objectives: This meta-analysis was performed to evaluate the efficacy of potassium nitrate and sodium fluoride as desensitizing agents during tooth bleaching treatment.
Data, sources and study selection: An electronic systematic literature search was conducted in Cochrane Center Register of Controlled Trials, MEDLINE (PubMed) and EmBase in April, 2014 in English and without time restrictions. Study information extraction and methodological quality assessments were accomplished by two reviewers independently. Methodological quality was assessed by using the ''Criteria for judging risk of bias in the 'Risk of bias' assessment tool''. Dichotomous data was summarized by odds ratio (OR) with 95% confidence interval (CI) and continuous data was summarized by mean difference (MD) or standardised mean difference (SMD) with 95% confidence interval (CI). Statistical analyses were carried out by using Review Manager 5.2.

For evaluation of percent of patients experiencing tooth sensitivity (POTS), the pooled OR of desensitizers vs. placebo was 0.45 (95% CI: 0.28–0.73, $P = 0.29$). The pooled SMD of desensitizers vs. placebo was −0.47 (95% CI: −0.77 to −0.18, $P = 0.13$) in evaluation of level of tooth sensitivity (LOTS). The results of shade evaluation remained inconsistent by evaluating subjective shade guide unit difference (ΔSGU or SGU) and objective colour difference (Δ*E*).
Conclusions: This meta-analysis was performed to evaluate the efficacy of desensitizing agents, potassium nitrate and sodium fluoride, for tooth bleaching treatments. Potassium nitrate and sodium fluoride reduce tooth sensitivity while no consistent conclusion of tooth colour change was found.

* *Corresponding author at*: Department of Prosthodontics, School and Hospital of Stomatology, Wuhan University, 237# Luo Yu Road, Wuhan 430079, PR China. Tel.: +86 27 87646696; fax: +86 27 87873260.
E-mail address: dryizhou@whu.edu.cn (Y. Zhou).
[1] These authors contributed to the work equally and should be regarded as co-first authors.
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1. Introduction

Q3 Following improvement in the economy and in people's living standards, an increasing number of people became self-aware that teeth play an important role in their appearance. These patients with discoloured teeth demand whiter teeth and a more aesthetically pleasing smile. According to a previous review, teeth whitening may be improved by physical or chemical approaches.[1] When comparing whitening toothpastes, professional cleaning, microabrasion of enamel with abrasives and acid, resin-bonded composites, porcelain veneers and crowns, tooth bleaching was considered a more accepted and conservative approach to improving the colour of teeth and a pleasant smile.[1–6] The main chemical approaches of tooth bleaching include at-home treatment, in-office procedure and bleaching with over-the-counter (OTC) bleaching products.[7,8] For at-home tooth bleaching treatment, 10% carbamide peroxide (CP) delivered in a custom-fitting mouth tray was introduced by Klusmier in late 1960s.[9] This successful technique was published by Haywood and Heymann in 1989 and has become the gold-standard treatment in tooth whitening.[9–12] Later the in-office procedure, of applying a high concentration of hydrogen peroxide (HP) to tooth bleaching with (or without) exposure to various kinds of heat or curing lights to enhance the effects became popular.[8,11–15] Typically a 30–35% concentration of HP is used in vital and nonvital tooth bleaching during in-office procedures.[11] Unlike at-home bleaching techniques, in-office bleaching is supervised by dentists. OTC products have increased in popularity with patients and are self-administered. Different OTC products have become available in markets, including whitening strips and gels, whitening rinses, paint-on gels with brushes, toothpastes, etc.[1,8,16] The safety and efficacy of OTC products remain questionable.[1,8,16,17] Evidence has shown that bleaching products based on CP and/or HP are relatively safe and effective when following manufacturer's instructions.[1,7,18]

Nevertheless adverse effects are another concern often expressed with bleaching.[19–21] Many publications have voiced concerns about oral health and potential tooth structure change after bleaching. Difficulty in dental hygiene, an unpleasant sensation in the mouth, gingival irritation, during and postoperative tooth sensitivity, structural integrity of dental hard tissue and restoration are common risks reported with tooth bleaching.[20,22–24] Tooth sensitivity and/or gingival irritation may be typical side effects associated with tooth bleaching techniques.[25] In previous reports, up to 66% of patients experienced side effects (tooth sensitivity and/or gingival irritation) after overnight vital bleaching.[26] This kind of discomfort is sometimes responsible for patients' hesitancy in tooth bleaching.

Modifications and improvements have been made to bleaching products. As compared with decreasing the concentration of peroxide products and administration of analgesic, the application of a desensitizing agent seemed to be an effective option to reduce tooth sensitivity.[27–29] Potassium nitrate and sodium fluoride as desensitizers are used widely to treat tooth sensitivity. These agents may be contained in bleaching gel and delivered by using a custom tray during treatment. Other delivery systems can be used independently by placing them into a subject's mouth for a short time before bleaching is introduced.[4,29–32] The mechanism of action of potassium nitrate remains unknown. Several randomized clinical trials have been published assessing the safety and efficacy of tooth bleaching treatments. Some of them conclude that desensitizers based on potassium nitrate and sodium fluoride reduce tooth sensitivity.[29,31–34] Others question the efficacy of tooth bleaching when a desensitizing agent is used.[4,30] The results of these studies are sometimes even conflicting, possibly because of the small number of patients. Therefore the aim of this meta-analysis is to provide a more accurate estimate of the efficacy of two desensitizing agents, potassium nitrate and sodium fluoride, during bleaching treatment.

2. Methods

All the work was performed by two reviewers, independently. A discussion ensued if any disagreement occurred and unresolved issues were solved by consulting a third reviewer.

2.1. Inclusion criteria

Clinical studies were included in this meta-analysis that satisfied the following inclusion criteria. Participants: patients with discoloured teeth (intrinsic discolouration and/or extrinsic discolouration) undergoing tooth bleaching treatment had to be randomized to test or control groups. The main approaches of tooth bleaching had to include at-home treatments and/or in-office procedures. Interventions: desensitizer agents had to be based on potassium nitrate and/or sodium fluoride intervention products. Comparisons: control products had to be placebo or other desensitizing agents. Outcomes: outcomes had to be arranged into two categories: tooth sensitivity evaluation and shade evaluation. Studies design: studies had to be designed as randomized controlled trials (RCT) or controlled clinical trials (CCT).

2.2. Exclusion criteria

Clinical studies were excluded in this meta-analysis that contained the following criteria: (1) those estimating the efficacy of over-the-counter (OTC) products which contained desensitizing components, such as dentifrice, whitening strips; (2) duplicate studies; (3) irrelevant studies; (4) in vitro studies.

2.3. Search strategy and study selection

An electronic systematic literature search was conducted in Cochrane Center Register of Controlled Trials, MEDLINE (PubMed) and EmBase in April, 2014 in English and without time restrictions. Additional studies were identified by searching reference lists of included studies and contacting experts. The medical subject headings (MeSH) and text words "hydrogen peroxide", "carbamide peroxide", "whitening", "tooth whitening", "bleaching", "tooth bleaching", "brightening", "aesthetics",

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