The effects of light on bleaching and tooth sensitivity during in-office vital bleaching: a systematic review and meta-analysis

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CRD summary
The conclusion was that light activation of tooth bleaching by a dentist increased the risk of tooth sensitivity, and might not improve the bleaching effect with high concentrations of hydrogen peroxide (25% to 35%). This was reasonable, but it was based on a few small trials.

Authors’ objectives
To evaluate the influence of light on bleaching efficacy and tooth sensitivity, during dentist bleaching.

Searching
MEDLINE, EMBASE and Cochrane Central Register of Controlled Trials (CENTRAL) were searched to September 2011, without language and publication date restrictions. Search terms were reported and reference lists of relevant studies were handsearched.

Study selection
Randomised controlled trials (RCTs) and quasi-randomised controlled trials that compared a light-activated bleach with a non-activated bleaching system were eligible for inclusion. Patients had to be adults aged 18 years or older who did not have systemic diseases or developmental conditions. Trials had to report the bleaching efficacy, tooth sensitivity or both. Light-activation could use any type of light lamp.

Most of the included trials were RCTs with between two and four groups. The light sources were: light-emitting diode (LED) or laser; halogen; metal halide; neodymium-doped yttrium aluminium garnet laser; or short-arc plasma light. The bleaching gel contained hydrogen peroxide at 20%, 25% or 35%, and administration time ranged from 15 to 20 minutes per session, with one or two sessions. Bleaching outcomes were measured on a shade guide or a digital imaging device. Tooth sensitivity was reported on a visual analogue scale (VAS), verbally, or as percentage of patients with tooth sensitivity.

Two independent researchers selected studies. Any disagreements were resolved by discussion and with a third reviewer as needed.

Assessment of study quality
Trials were assessed by two independent researchers using the Cochrane Risk of Bias tool. Any disagreements were resolved by discussion and with reference to a third reviewer as needed.

Data extraction
Bleaching and sensitivity outcomes were extracted including overall colour change. Where change was not reported, it was calculated. Tooth sensitivity data were extracted if they were recorded immediately after bleaching, as there was considerable variation in the desensitising procedures. Five trial authors were contacted for further information.

It appears that two reviewers were involved in data extraction.

Methods of synthesis
A random-effects model was used to calculate the mean difference for continuous outcomes, and the odds ratio for dichotomous outcomes, along with associated 95% confidence intervals. Bleaching results were grouped by follow-up time: immediate (within one day), short term (one to four weeks), and medium term (12 to 24 weeks). Heterogeneity was assessed using Cochran’s Q and I², with significance set at a probability of less than 0.1. Where there was significant heterogeneity, the influence of low-quality trials was explored.

Results of the review
Eleven studies, with 462 participants, were included in the review. Nine were RCTs and two were controlled trials. Five RCTs were at a low risk of bias, and four were judged to be at a moderate risk; the two controlled trials were judged to be at a high risk of bias. Eight of the RCTs reported blinding the assessors to allocation.

**Immediate effect:** Seven trials used visual measures of the immediate colour change. There was significant heterogeneity between the trials, which were analysed by hydrogen peroxide concentration, and the two non-randomised trials were removed. There was no evidence of a difference between light-activated and non-light activated systems with a high concentration of hydrogen peroxide (25% to 35%; three trials). There was a significant difference in favour of light-activated systems with low concentrations of hydrogen peroxide (15% to 20%), with a mean difference of -1.78 (95% CI -2.30 to -1.26; two trials).

**Short-term effect:** Four trials used visual scales and three trials used instrumental measures. There were mixed results and substantial heterogeneity. Subgroup analyses found no significant difference in three high-concentration trials, but one low-concentration trial reported a significant effect.

**Medium-term effect:** Two trials reported visual measures; one also reported an instrumental measure. One trial used low-concentration hydrogen peroxide and reported a significant difference with light activation, while the other used a high concentration and found no differences in outcomes.

**Tooth sensitivity:** Four trials reported on the presence or absence of tooth sensitivity. Meta-analysis showed a significantly higher risk of sensitivity with light activation (OR 3.53, 95% CI 1.37 to 9.10). Three trials reported the degree of tooth sensitivity, and meta-analysis indicated that non-light activated systems were associated with less sensitivity (MD 0.57, 95% CI 0.21 to 0.92). No significant heterogeneity was noted for either analysis.

**Authors’ conclusions**
Light activation of bleaching increased the risk of tooth sensitivity and might not improve bleaching when high concentrations of hydrogen peroxide (25% to 35%) were used. It could improve the immediate effect with low concentrations, but further research was needed.

**CRD commentary**
This review addressed a clear question and used appropriate databases and search terms, without language and publication restrictions. The review processes were generally well described and are likely to have reduced the impact of reviewer error and bias. The included trials were assessed for risk of bias and partly described, but there was little information on the patient characteristics. The analyses appear to have been appropriate and the trials were grouped by reliability and intervention type.

The authors acknowledged the small number of trials and drew appropriately cautious conclusions for tooth bleaching, but the statement that light-activated bleaching increased the risk of sensitivity was based on three small trials.

**Implications of the review for practice and research**
**Practice:** The authors recommended that dentists should be cautious in using light-activated systems for tooth bleaching, or avoid their use altogether until further research has been carried out.

**Research:** Rigorous RCTs were required to evaluate the impact of light-activated tooth bleaching systems, with lower concentrations of hydrogen peroxide, and these trials should use multiple measures of effectiveness.

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