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## **Impact of Adverse Events on Color Change During Vital Bleaching: Meta-Analysis of 6 Clinical Trials**

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**Objective:** While tooth sensitivity and oral irritation are commonly reported during bleaching, any relationship between these events and effectiveness has not been established. This meta-analysis was conducted to evaluate the impact of adverse events on objectively measured color change during the vital bleaching process. **Methods:** Data from 6 randomized clinical trials were included in the meta-analysis. This inclusive data set represented all clinical trials using common entrance criteria and measurement methods. The pooled data were limited to subjects who used 6.0% hydrogen peroxide bleaching strips twice daily over a 14-day period. In all studies, effectiveness (color change) was measured objectively using digital image analysis of the maxillary teeth, while tooth sensitivity and oral irritation were assessed by subject report. The meta-analysis adjusted for study effects, as well as key demographic and baseline values. **Results:** A total of 106 subjects were included in the pooled sample. Of these, 23% reported tooth sensitivity and 19% reported oral irritation by Day 14. Mean  $\Delta b^*$  color change (95% CI) was -2.29 (-2.60, -1.98) for symptomatic subjects compared to -2.00 (-2.26, -1.74) for asymptomatic subjects. By type, subjects having both tooth sensitivity and oral irritation experienced the greatest color improvement with a mean  $\Delta b^*$  (95% CI) of -2.77 (-3.84, -1.71). Subjects having only tooth sensitivity or oral irritation had higher responses than asymptomatic subjects, averaging -2.17 and -2.39  $\Delta b^*$ , respectively. Findings were generally consistent at Day 7 and across other color parameters ( $\Delta L^*$ ,  $\Delta a^*$ ,  $\Delta E^*$ ). **Conclusion:** Common adverse events associated with vital bleaching did not degrade color improvement during 14-day treatment with 6.0% hydrogen peroxide whitening strips.

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## **Tooth Whitening Effect: Confocal Microscopy/Raman Spectroscopy Studies**

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Safe and effective vital tooth bleaching requires the development of formulations which produce aesthetic improvements in tooth appearance while maintaining the surface and subsurface integrity of hard tissues and restorative materials. **Objectives:** This study examined the effects of bleaching gels on the micro-chemical composition of enamel and dentin *in vitro*. **Methods:** Human molars were mounted in methacrylate blocks. Color determinations (CIELAB) of standardized areas on surface enamel were taken by image analysis. Teeth were bleached with Crest Whitestrips™ commercial gel base containing either 6.0 % H<sub>2</sub>O<sub>2</sub> (14 hours) or 6.5 % H<sub>2</sub>O<sub>2</sub> (70 hour). Placebo gel treated molars served as controls. In a prototype experiment a series of subsurface CLSM-microtomographic images combined with simultaneous Micro-Raman spectra were recorded on transverse sectioned teeth permitting subsurface evaluation of ultrastructural and micro chemical effects on enamel and dentin. **Results:** Micro-Raman spectral properties were compared for test and control specimens as subsurface line scans in defined intervals. Particular attention was paid to the mineral PO<sub>4</sub> (954 cm<sup>-1</sup>), CO<sub>3</sub> (1071 cm<sup>-1</sup>) and non-apatite HPO<sub>4</sub> (1002 cm<sup>-1</sup>) vibrations characteristic of hard tissue integrity. The CLSM and Micro-Raman tomographic and spectral properties of bleached enamel were unchanged from control enamel specimens. **Conclusions:** The CLSM and Raman spectroscopic properties of enamel and dentin appear unchanged in bleaching processes representative of those encountered in vital tooth bleaching. These chemical observations support the safety of vital tooth bleaching to the hard tissues.