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# The Efficiency of an Experimental Low Concentration Hydrogen Peroxide Gel Photoactivated with an Experimental Hybrid Light Source: A One Year Follow-Up Case Report

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## Abstract

Now a days, an aesthetic smile requires adequate shape, size, function and bright tooth color. Vital dental bleaching is one of the most challenging of all aesthetic treatments to achieve a white smile. This treatment consists of low-concentration carbamide or hydrogen peroxide bleaching materials used in home bleaching or high concentration bleaching materials used in conventional in-office bleaching. Current in-office dental bleaching utilizes low-concentration hydrogen peroxide activated with hybrid light to obtain a reduction of post-operative dental hypersensitivity and immediate aesthetic results can be employed. This case report describes an easy and reliable dental office bleaching procedure using a 10% experimental hydrogen peroxide gel associated with an experimental hybrid light composed of violet LED and Diode laser light sources, with good results after a one year follow up with no tooth hypersensitivity.

## Keywords

Tooth bleaching; Hydrogen peroxide; Dental hypersensitivity; Light source

## Introduction

In-office bleaching has been improved with advanced clinical techniques such as the use of an additional light source that increases the temperature of dental bleaching products, which causes the acceleration of the hydrogen peroxide reaction into multiple components (hydroxyl radicals) and therefore, promotes more efficient and faster dental bleaching [1].

Several light sources such as halogen light, high energy plasma arc, blue, green and red LED (light emitting Diodes), light emitting diodes (LEDs) associated with therapeutic Diode laser, ultraviolet light and neodymium:YAG, argon or CO [2] lasers. Each dental bleaching device presents its own characteristics, such as the wavelength, power density and temperature of the emitted light, which may interfere with the effectiveness of the treatment [2]. Low-concentration hydrogen peroxide (HP) gels (15%) associated with nitrogen-doped titanium oxide nanoparticles were recently launched in the

requires photoactivation with a commercially available hybrid light source (blue LED and Diode laser). A 10% experimental HP gel was used in the present clinical case which presents the same characteristics as the aforementioned gel in association with experimental hybrid light composed of violet LED and Diode laser light sources (furnished by the manufacturer) to promote a more effective, safer and less damaging dental bleaching procedure. The use of a high concentration HP gel with or without light activation can increase the risk of tooth hypersensitivity after dental bleaching. Given this, the use of low concentration bleaching gels activated with a hybrid light source can reduce post-operative sensitivity and consequently, dental damage [2,3].

This clinical case report aims to show the efficacy of an experimental bleaching agent (10% HP) activated with an experimental hybrid light source whose chemical reaction is increased by the presence of nitrogen-doped titanium oxide nanoparticles.

## Materials & Methods

*Materials:* The materials and equipment used for the present study are outlined in Table 1.

| *MATERIAL/MANUFACTURER* | *DESCRIPTION* |
|---|---|
| **10% $H_2O_2$ experimental gel** (DMC Equipamentos Ltda., São Carlos, SP, Brazil) (Registro Anvisa 25351.706466/2008-29) | 10% Hydrogen peroxide gel, with nitrogen-doped titanium oxide nanoparticles |
| **Violet hybrid light source** (Experimental, DMC Equipamentos Ltda., São Carlos, SP, Brazil) (Registro Anvisa 25352.289996/2005-46) | 6 violet LEDs (350 mW/cm² power density/ 415nm wavelength each)<br><br>3 Diode lasers (200mW power density/ 810nm wavelength each) |

**Table 1:** Material, equipment and manufacturer used

## Methods/Case Report

Eighteen year old female patient was presented to the institution´s clinic (Bauru Dental School) complaining of her unsatisfactory tooth color in the upper and lower maxillary. The anamnesis and oral examination showed no abnormalities (Figure 1). The initial color (A2 and A3) was determined by the Vita Lumin color scale (Vita-Zanhnfabrik, Bad Säckingen, Germany). Dental prophylaxis was performed and a gingival barrier (Lase Protect, DMC Equipamentos Ltda., São Carlos, SP, Brazil) was applied in both arches.

Phosphoric acid at 37% was applied for 15s over the vestibular faces of all teeth in order to partially remove the external aprismatic enamel, increasing the permeability of the bleaching gel [1,2]. The experimental 10% hydrogen peroxide gel (DMC Equipamentos Ltda., São Carlos, SP, Brazil) was manipulated according to the manufacturer's instructions - 3:1 (30 drops of hydrogen peroxide / 10 drops of thickener). A 1mm layer of the bleaching gel was applied on the vestibular surfaces. After one minute, the bleaching gel was photoactivated approximately at a 1 cm distance for 3 consecutive minutes,

with one minute of interval and another 3 minutes photoactivation (total of 8 minutes) over the vestibular face of the teeth (Figure 2) with an experimental violet hybrid light source (DMC Equipamentos Ltda., São Carlos, SP, Brazil). The hybrid light tip employed has six violet LEDs (350 mW/cm$^2$ power density/ 415nm wavelength each) and three Diode lasers (200mW power density/ 810nm wavelength each).

This procedure was repeated for a total of 5 bleaching gel applications in the same session, totaling 40 minutes of gel action. The finishing procedure was performed with a felt disk and aluminum oxide paste (Aluminium Oxgloss 1 and 2, KG Sorensen, Cotia, SP, Brazil) to achieve a shiny and luster bleached enamel (Figure 3).

## Results

The final A1 shade lightened the patient´s smile and showed pleasing aesthetic results. No tooth hypersensitivity was reported. A one-year follow-up showed the long-term success of the dental bleaching using a low concentration of hydrogen peroxide gels maintaining good aesthetic results (Figure 4).

## Discussion

High concentrations of hydrogen peroxide have deleterious effects on the dental pulp, causing mild to moderate inflammation [4] that could lead to dentin hypersensitivity and acute pain. The higher the concentration of $H_2O_2$, the deeper the microporosities created by the product in the enamel, which favors the diffusion of the peroxide and its byproducts towards the pulp chamber [2].

The most important factor for the use of low concentrations of $H_2O_2$ gels is the decrease of hypersentivity with in-office bleaching, mainly with young patients with large pulp chambers or patients undergoing orthodontic treatment. In a histological study, Costa et al. (2010) showed that the lower incisor teeth, after 2 days of in-office dental bleaching with 38% $H_2O_2$ gel, suffered irreversible pulpal damage[4]. Gels with low concentrations of $H_2O_2$ present a neutral or higher pH and, consequently, less damage after bleaching and simulated brushing on the enamel (roughness and wear) [3].

Tooth sensitivity may not only be related to the peroxide concentration but also most likely related to the time/length of the gel application in contact with the dental structure (higher for home use agents), as well as the presence, type, and concentration of desensitizing agents in the gel composition[5]. In an attempt to decrease dental sensitivity during bleaching procedures, manufacturers have introduced different desensitizing agents into the composition of the bleaching agent, such as potassium nitrate, sodium fluoride, or amorphous calcium phosphate still in experimental testing [5].

When lower concentrations of $H_2O_2$ (15 - 25%) were used during in-office bleaching, light activation produced better immediate bleaching effects in less time, similar to using a high concentration of $H_2O_2$ with light activation[1]. Light activation facilitates the photolysis of $H_2O_2$, whereby increments of hydroxyl radicals compensated for the low concentrations of hydrogen peroxide [6]. This is in accordance with Bortolatto *et al.*, (2014) which showed that 15% $H_2O_2$ gel containing TiO_N nanoparticles is greater in its efficacy compared with the traditional treatment with 35% $H_2O_2$ gel without TiO_N nanoparticles while providing a lower occurrence of tooth sensitivity [7].

Light activation with bleaching procedures has also been studied, with positive results. In accordance of Andreatta et al., 2015, the whitening gels at different concentrations associated with hybrid light sources showed little change in the temperature increase of the pulp chamber and the greatest increase in temperature did not exceed 2°C [8] and this could be explained by the lower occurrence of tooth sensitivity,especially when hydrogen peroxide gel is doped with TiO_N nanoparticles.

In the present clinical case, the use of an experimental violet LED-laser hybrid light to activate 10% hydrogen peroxide gel with TiO_N nanoparticles permits the decrease of the peroxide concentration with good aesthetic results in just one session. These findings are in accordance with Martín et al., (2015), where 15% hydrogen peroxide bleaching gel containing TiO_N nanoparticles, activated by a hybrid light source (LED-laser) showed similar results to 35% hydrogen peroxide gel with less pulpal sensitivity [9]. This new experimental hybrid light source activates the photo-activated nanocatalyst particles, promoting greater breakdown of hydrogen peroxide and consequently, greater release of oxygen ions[8].

The composition and concentration of the bleaching gel agents, activated with a hybrid light source or not, side effects involved (such as tooth sensitivity), and effectiveness must be taken into consideration when choosing the safest bleaching treatment for each patient. Based on this finding, the use of low-concentration bleaching gels is recommended for young patients to decrease tooth sensitivity with good aesthetic results.

## Conclusion

The use of a 10% $H_2O_2$ experimental bleaching gel with TiO_N nanoparticles activated with an experimental hybrid light source (violet LED/Diode therapeutic Laser) allowed for fast, effective and safe dental bleaching with less or no tooth sensitivity in just one bleaching session, maintaining excellent results at the one year follow up.

## Figures

**Figure 1:** Initial oral view.

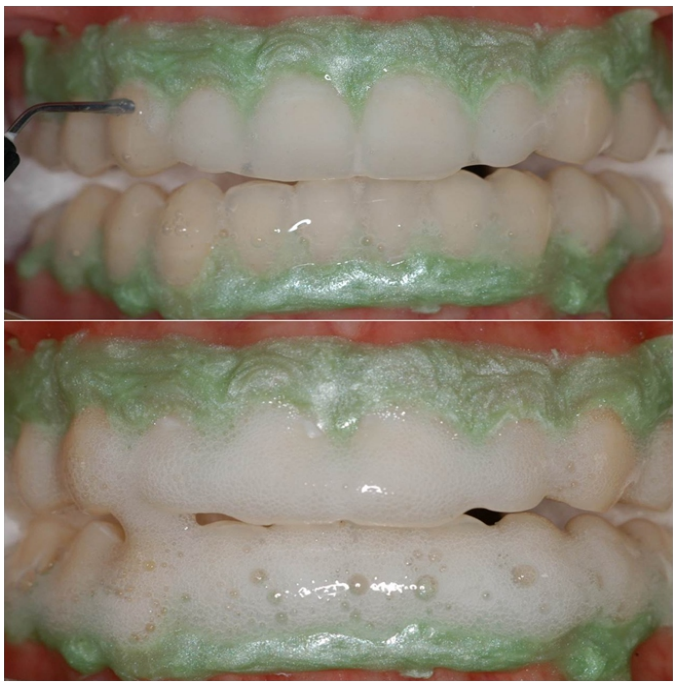

**Figure 2:** 10% hydrogen peroxide gel before the first light activation and after the final activation.

**Figure 3:** Immediate oral view.

**Figure 4:** One year post treatment oral view

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