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New Trends on In-office Tooth Bleaching

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The minimally invasive dentistry philosophy establishes that techniques must be the least harmful as possible [1]. Getting results briefly and maintaining the effectiveness of the procedures are common challenges of science and technology in the advancement of dentistry. Another important factor is the increasingly request of patients for aesthetic treatments, seeking ideal cultural standards which depend on their region or country of origin.

Dental aesthetics contributes to health and beauty, and it is part of the quality of life imposed by the modern society [2]. The smile is the first thing people see when they meet a person, it's part of the first impression, thereby any alteration in the shape and/or color has a negative impact on the person self-esteem, even affecting their psychological and social behavior [3]. Within the characteristics of the smile, the tooth color is far the most important factor, determining the satisfaction with the dental appearance [4].

The color alteration of one tooth or darkening teeth can be treated by tooth bleaching, a simple and minimally invasive procedure [5]. The bleaching agents' mechanism of action is based on the release of reactive forms of oxygen, due to the interaction of peroxide with the tooth structure. The oxygen reactive forms of low molecular weight permeate the tooth structure by inter prismatic spaces, penetrating the enamel and dentin where they act on complex organic molecules, which have long chains with double bonds and aromatic rings [6]. The breaking of these double bonds, making these long chains into smaller chains causes a decrease in the rate of light absorption by the tooth structure, and consequently the tooth bleaching[7-9].

Basically, two bleaching techniques are available: at-home and in-office. At-home bleaching employs low concentrations of bleaching agents (10-22% carbamide peroxide) applied to the tooth surface using customized trays [10]. This technique presents some advantages as ease of use, reduced chair time and high success rate. However, in-office bleaching has become more popular because it may achieve tooth whitening faster due to the use of high concentration bleaching agents. In-office tooth bleaching is traditionally performed using hydrogen peroxide in high concentrations (35-38%) [11], which can be light activated

by light sources such as plasma arcs, xenon, halogen lamps and low-intensity light such as LED/Laser[12-16] systems in order to accelerate the bleaching process.

Although it is considered a safe technique, studies have emphasized the potential side effects of this procedure to dental tissues. The penetration hydrogen peroxide and/ or its free radicals towards the dental pulp during bleaching process may lead to the tooth sensitivity occurrence trans and post treatment. It is the side effect most reported by patients (45-90%) and many times ignored by dental practitioners [17]. There are also reports in the literature that suggest that hydrogen peroxide in high concentrations (> 35%) may induce cell damage [18].

Hence, currently, tooth bleaching has been regulated by different institutions and Government of the countries. The European Union (EU) banned the use of bleaching agents in concentrations above 6% of hydrogen peroxide by dental professionals, and American Dental Association (ADA) recommends bleaching agents containing 10% carbamide peroxide used in trays at home as a safe procedure for tooth bleaching [19].

Due to the reasons cited above, new technologies have been introduced, aiming to combine increased safety and efficiency in dental bleaching. Low concentrated in-office bleaching gels were released in the market (15-20%) [20-23], but unfortunately, despite minimizing the tooth sensitivity; they don't reach the same bleaching efficacy. More recently, the incorporation of titanium dioxide nanoparticles doped with nitrogen (TiO₂N), as semiconductor agents, to bleaching agents with lower concentration of hydrogen peroxide (3.5-15%) have been introduced [4,24,25]. The TiO₂N nanoparticles, when activated by a light source, can catalyze the hydrogen peroxide oxidation reaction, allowing reduction of agent concentration. Also the chemical reaction would be maintained at a more superficial level, reducing the hydrogen peroxide penetration towards the pulp-dentin complex. These formulations aimed increased safety and maintenance of efficacy over conventional formulations. While for the agents with high concentration of hydrogen peroxide the activation by light sources remains controversial in the literature [26-28], activated by light systems produce better results than non-activated ones when lower hydrogen peroxide

concentrations (15 to 20%) are used [29].

Several clinical trials have investigated the effectiveness of the concentration of 15% hydrogen peroxide containing TiO₂N compared to a traditional bleaching agent (35% hydrogen peroxide) [20,22,30]. The results showed maintenance of the effectiveness and a drastic reduction of tooth sensitivity. Bortolatto et al. reported greater efficacy and a reduction of 52% in the occurrence of tooth sensitivity when the bleaching agent of 15% hydrogen peroxide containing TiO₂N was used compared to 35% hydrogen peroxide [20]. More recently, a bleaching agent with concentration even lower, 6% hydrogen peroxide containing TiO₂N nanoparticles, has been studied [4,31,32]. Martin et al. (23) evaluated the efficacy of this new bleaching agent with 6% of hydrogen peroxide containing TiO₂N [24]. They showed a reduction of the tooth sensitivity intensity and a clinically insignificant lower effectiveness a 35% hydrogen peroxide agent. The reports above indicate that the present and future of tooth bleaching is in reducing the concentrations of hydrogen peroxide, reducing adverse effects and, likely, causing minor damages to the cells [33,34].

Regarding the effect on the aesthetic perception and psychosocial impact, there are some reports of Martin et al [4] and Fernandez et al [24] showing a positive effect on these two areas, topics that you should be much more investigation in the future.

A recent article by Vildosola et al [35] showed no differences on effectiveness with two different protocols (one of 36 minutes or three of 12 minutes by two sessions) to low concentration bleaching gel (6%). These results agree with Martin et al who describe a change of 5 delta E tones with 6% gel in the office [4], but with different application protocols: 1) 3 sessions with 2 applications, each for twelve; 2) 2 sessions with 3 applications for 12 minutes, and 3) 2 sessions with 1 application of 36 minutes. All of these approaches are equally effective.

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