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CASE REPORT
Office Bleaching with Er:YAG Laser

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ABSTRACT

Office bleaching procedures consist of the application of a bleaching gel that contains a respectively high percentage of H_2O_2 onto the teeth, followed by the application of heat to the gel using one of various possible light sources to accelerate the dissociation of H_2O_2 into oxygen radicals. The Er:YAG laser has been described as the most recent laser wavelength to be used for office bleaching treatments. This report presents the use of the Er:YAG laser (LightWalker, TouchWhite™ Protocol, Fotona) for office bleaching. A relatively low pulse energy (40 mJ), long pulse duration (VLP) and the large spot size of the handpiece (R17) used ensure the safety of dental hard tissues by reducing the fluence of laser pulses below the ablation threshold of enamel and dentin, as well as below the ablation threshold of water. In this clinical case, the Er:YAG laser-assisted bleaching that was performed according to the TouchWhite™ protocol resulted in an effective and safe treatment.

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I. INTRODUCTION

Discoloration of teeth is a common aesthetic problem and bleaching is the most conservative treatment option when compared to other restorative techniques used to change tooth color. The mechanism of the bleaching process is based on the penetration of different oxygen radicals, which occurs during the decomposition of hydrogen peroxide (H_2O_2) [1] into discolored dentin, thus modifying the dentin colorant molecules through an oxidation reaction [2]. There are two different clinical procedures for bleaching treatments, described as "office bleaching" and "home bleaching". The office bleaching procedure consists of the application of a bleaching gel that contains a relatively high percentage of H_2O_2 (30-40 %) onto the teeth followed by a heating-up of the gel to accelerate the dissociation of H_2O_2 into oxygen radicals by using various light sources.

There are many different light sources that can be used for office bleaching, such as halogen lamps, light emitting diodes, plasma-arc lamps and lasers with different wavelengths. Recently, the Er:YAG laser has been described as a new, safe and effective light source option for office bleaching treatments [3]. Generally, the major component (40-55 % by weight) of bleaching gels is water, and it is well known that the Er:YAG laser is highly absorbed in water. Because of the water content of bleaching gels, there is no need for the presence of an additional energy-absorbing component. In addition, the high absorption of Er:YAG laser energy in aqueous gel (in the first 10-50 microns of the gel) makes the procedure quite safe for the health of vital pulp by eliminating the potential risk of overheating the pulp [3].

In this paper, we present an office bleaching treatment performed using an aqueous bleaching gel and Er:YAG laser.

II. CASE DESCRIPTION

A 25-year-old male patient visited our clinic with a complaint about his tooth color. He was a healthy patient without any systemic medical disorder and was a non-smoker. During examination, it was observed that there was no tooth loss, positional disorder, morphologic malformation, periodontal or endodontic infection or persistent structural staining at the anterior region (Figure 1). The decision was made to perform an office bleaching treatment to whiten the teeth in a conservative manner and to improve the aesthetics.

Fig. 1: Initial situation of the teeth.

At the beginning the patient was informed about the benefits and potential risks and complications of the bleaching treatment. Also, the interactions and possible positive (effectiveness and short application time) or negative (possible hypersensitivity due to the bleaching treatment, chemical irritations on the tissue surfaces due to possible contact of the bleaching gel to mucosa) outcomes of an Er:YAG laser treatment were explained to the patient in understandable terms. Laser safety rules were strictly executed.

Firstly, the superficial stains on the teeth were removed by polishing with a bristle brush and polishing paste (Topex prophylaxis paste, Sultan, NJ; USA). Shade determination was made using a shade guide (Vita classical shade guide, Vita Zahnfabrik, Bad Sackingen; Germany) and it was determined that the initial shade of the teeth matched to shade A2 (Figure 2).

Fig. 2: Initial shade determination using Vitapan Classic.

A water-based bleaching gel (Opalescence Boost, Ultradent, South Jordan, UT; USA) with 40% H2O2 content was selected for this treatment. The gum protection gel (Opaldam Green, Ultradent, South Jordan, UT; USA) that was supplied by the manufacturer was applied onto the gingival margins of the teeth and light-cured using a high intensity LED curing unit (Figure 3). The two components of the bleaching gel were mixed as described by the manufacturer using the system component syringes (Figure 4). The mixture was applied onto the teeth at a thickness of about 1 mm according to the manufacturers' instructions and irradiated with the Er:YAG laser (Figure 5).

Fig 3: Gum protection gel applied onto the gingival margins.

Fig. 4:. Bleaching gel mixture.

Fig. 5: Gel application and irradiation.

The irradiation procedure was performed with a Fotona LightWalker AT laser device (Fotona, Ljubljana; Slovenia) according to the Fotona TouchWhite™ protocol (R17 handpiece, 40 mJ (delivered fluence per pulse: 0.2 J/cm^2), 10 Hz, VLP mode (pulse duration: 1000 µsec), 20 sec per tooth, 3 times on each application of the bleaching gel) (Figure 6). The gel application and irradiation cycle was performed three times during the treatment process.

Fig 6: TouchWhite™ bleaching handpiece (R17).

After the treatment, the bleaching gel was suctioned and washed away. The final shade determination was made using the same shade guide and the final shade of the teeth was identified as A1 (Figure 7). The patient was happy about the final color and the teeth were not sensitive during or after the procedure. The gum protection gel was removed and the patient was advised to avoid foods with colorants.

Fig. 7: Final shade of the teeth.

III. DISCUSSION

Since the activation of bleaching gels using heat sources to accelerate the decomposition of H2O2 was first described by Abbot [4] in 1918, there have been numerous light sources used in bleaching procedures. The most common concern about this gel heating process is the potential overheating of the teeth, which can irreversibly damage the vital pulp if the temperature rise inside the pulp exceeds 5.6 ºC [5]. There are some in vitro studies in the literature reporting such high temperature rises with different light sources, including diode lasers [6, 7].

The Er:YAG laser has been described as the most recent laser wavelength to be used in office bleaching treatments. There is not much information about Er:YAG bleaching in the literature, however, Gutknecht et al. [3] have reported that the energy of the Er:YAG laser is almost totally absorbed in the bleaching gel because of the water content of the gel; the gel acts as an absorbent barrier that prevents the transmission of energy through the hard tissues. Because of this interaction, when using an Er:YAG laser with aqueous bleaching gel, all of the energy is used to heat-up the gel, and the surrounding tissues remain safe.

It is well known that the Er:YAG laser has the capability for hard-tissue ablation. However, the TouchWhite™ protocol recommended by Fotona and used in this case consists of parameters which are safe for hard dental tissues. Relatively low pulse energy (40 mJ), long pulse duration (VLP) and the large spot size (5 mm) of the handpiece (R17) provides for the safety of hard dental tissues by reducing the fluence of the laser pulses to below the ablation threshold of enamel and dentin.

IV. CONCLUSIONS

In this clinical case, the Er:YAG laser-assisted bleaching that is performed according to the guidance of the TouchWhite™ protocol resulted in an effective and safe treatment.

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