TouchWhite™ Er:YAG laser-assisted Tooth Whitening

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_Cosmetic dentistry has become a very important part of dental practice. Studies show that at least one-third of the population is not satisfied with the color and form of their natural teeth.[1–3] It has been estimated that among patients who present themselves for cosmetic treatments, up to 15% suffer from psychiatric conditions termed Body Dysmorphic Disorder (BDD), also known as dysmorphophobia, which literally means "fear of ugliness".[4,5] BDD has an estimated prevalence of 1% to 2% in the general population and is characterized by a preoccupation with a slight or imagined defect of some aspect of physical appearance. With the increasing demand for esthetic dental care, it is clear that tooth bleaching can present a minimally invasive cosmetic approach.

Vital tooth bleaching is an increasingly popular treatment in dentistry. In order to enhance or to accelerate the whitening process, heat activation of the bleaching agent by light, heat, or laser has been introduced. Some manufacturers of laser- or light-based bleaching systems claim that there is improved light absorption, reduced tooth heating, and even photochemical activation of the bleaching gel following the addition of an activator, absorber or colorant.[6,7]

In a systematic review, Buchalla and Attin concluded that there was no real evidence of photochemical bleaching, and that power bleaching was a result of photothermal activation.[8] Additionally, they have also warned that activation of bleaching agents by light or laser may have an adverse effect on pulpal tissue due to an increase of intrapulpal temperature exceeding the critical value of 5.6 °C. This is due to the fact that in a typical laser- or light-activated bleaching, the light is not fully absorbed in the relatively thin layer of the gel that is deposited on the tooth surface. As a result, the laser energy is transmitted into the dental tissue. This can lead to an undesired heating of the whole tooth and of the dental pulp, possibly leading to pain and irreversible damage.

_TouchWhite™ Er:YAG laser-assisted bleaching

The review by Buchalla and Attin[6] was performed before the introduction of the TouchWhite™ method for Er:YAG laser-assisted tooth whitening.[9] The TouchWhite™ method makes use of the fact that the Er:YAG laser wavelength has a water absorption peak in the vicinity of 3 µm. Since water is the major component of the aqueous bleaching gels, this eliminates the need for any additional absorbing particles in the bleaching gels. More importantly, taking into account thermal burden considerations, the TouchWhite™ procedure represents the most effective and least invasive laser-assisted tooth whitening method possible. Due to its high absorption in bleaching gels, the Er:YAG laser beam is fully absorbed in the gel and does not penetrate to the hard tissue or the pulp. All of the laser energy is thus effectively used for the heating of the gel. There is no direct heating of the dental tissue and the pulp, as is the case with other laser-assisted whitening methods.

Figure 1 shows the side view thermal image of a tooth during Er:YAG or diode laser (810 nm) illumination of the bleaching gel.[10] Since the Er:YAG wavelength is fully absorbed in the gel, there is no direct heating of the underlying tooth. On the other hand, the diode wavelength is relatively weakly absorbed in the gel, and the transmitted light directly

heats up the whole tooth. For this reason, the Er:YAG laser power is utilized more effectively, and the gel can be heated to higher temperatures without compromising the safety of the tooth or of the pulp. As a consequence, the TouchWhite™ procedure can be performed with a minimal undesirable thermal burden on the tooth, and the tooth whitening speed can be safely increased by 5–10 times.[10]

The TouchWhite™ method was first proposed and studied by the Laser and Health Academy in partnership with Fotona. Later, the Aachen Dental Laser Center (AALZ) in Germany performed a detailed *in vitro* study of the temperature elevation in the pulp chamber under different Er:YAG laser-whitening scenarios, followed by a clinical study of Er:YAG laser-assisted whitening.[10–12] Both studies confirmed the TouchWhite™ method to be safe and very effective in shortening the activation times of the bleaching gels.

An introductory clinical study of the TouchWhite™ procedure was also made by Dr Jugoslav Jovanovic of the Kozarac Dental clinic in the Republic of Srpska, BH. This study tested an Er:YAG laser-assisted whitening method in which the bleaching gel was illuminated in three sequences of 20 seconds, with 10 seconds of waiting time between the illumination sequences (according to the studies made by Fotona and AALZ, this illumination mode can shorten the bleaching time from 10 minutes down to 1.5–2 minutes). A Fotona Fidelis Plus Er:YAG laser with an R093 collimated bleaching handpiece was used in the study. The laser settings were as follows: laser power 0.55 W, repetition rate 10 Hz and pulse duration VLP. Five patients with 16 intrinsically stained teeth (12 vital and 4 non-vital) were treated with the Fotona teeth whitening gel (35 % H_2O_2). One to three treatment sessions were made depending on the intensity of discoloration. The results of this introductory study confirmed that the Er:YAG laser applied in the three sequence mode can be safely and effectively used for teeth whitening of vital and non-vital tooth discoloration. None of the patients felt any heating of their teeth or pain during the treatment. Only one patient developed a temporary hypersensitivity after the bleaching, however, this sensitivity was attributed to the gel activity itself. The results of this study have already been presented at the 5th SOLA Congress in Vienna in 2009.[13] Since then, the TouchWhite™ tooth bleaching procedure has been performed on more than 40 patients. In comparison with diode and Nd:YAG bleaching, the Er:YAG laser-assisted whitening method proved to be more comfortable for patients while achieving the same or better whitening efficacy at shorter treatment times. As an example, Fig. 2 shows before and after photos for one of the cases.

_The Er:YAG laser-assisted bleaching procedure

An appointment for Er:YAG laser bleaching is typically scheduled to last approximately 45 minutes. Before the start of the initial preparation, photographs are taken and general health status is established regarding possible indications or contraindications such as: leaking restoration, periodontal problems, caries, neck sensitivity, enamel fractures and cracks, insufficient oral hygiene, expectations of the patient, endodontic problems or TMJ disorders.

The steps of the procedure are performed in the following order:

A) Placement of cheek and lips retractor

(OptraGate, Ivoclar Vivadent; Schaan, Liechtenstein)

B) Teeth preparation

Extrinsic stains, plaque, debris are removed with pumice in order to obtain optimal results. Any organic material remaining on the tooth surface would interact with the bleaching agent, thus reducing effectiveness. Conventional polishing pastes should not be used because they may contain oils that inhibit the bleaching reaction.

C) Photographs of teeth before procedure

Once the pre-treatment photos are completed the procedure may begin.

D) Insertion of bite blocks

Bite blocks or a combination bite block and saliva aspirator is placed.

E) Gingival protection

Soft tissues should be protected from the hydrogen peroxide gel and laser light. Also, the hypersensitive dental neck should be protected from the

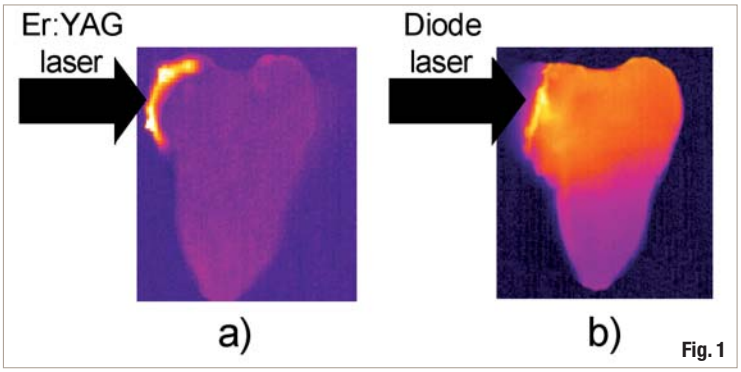


Fig.1_Side view thermal images of a tooth under Er:YAG laser (a), and diode laser (b) illumination.

Fig. 1



Fig. 2a & b_Photos before and after Er:YAG laser assisted whitening procedure.

bleaching gel in order to avoid undesirable pain during the procedure. The teeth and gums are dried with compressed air and a gingiva protector (that comes with the Fotona bleaching kit) is placed on the exposed cervical root surface (1–1.5 mm) and cervical gingival tissues (4–5 mm).

F) Application of the bleaching gel

The Fotona Bleaching kit contains gingival protection flowable resin material, bleaching gel and after-bleaching care material, packed in a syringe. The complete bleaching kit should be stored in a refrigerator (temp. 3–8 °C). Before the application, the kit is taken out of the refrigerator, the gel is mixed in the amount needed for the procedure, and the mixed gel is left to rest for 4–8 min at room temperature. The gel is then applied to the teeth with a spatula in a predetermined sequence 11-21-13-23-24-14-15-25-12-22 for the upper teeth and 33-43-34-44-35-45-32-42-31-41 for the lower teeth.

G) Protection of the patient, assistant and dentist with protective goggles

Although the Er:YAG laser beam is less dangerous for the eyes in comparison to other laser wavelengths that are transmitted through to the retina (KTP, diode or Nd:YAG), protection goggles are mandatory.

H) Irradiation with the Er:YAG laser

Every tooth is irradiated for 20 sec in the same sequence as the gel application. The parameter settings are as follows: Fotona Er:YAG laser, frequency 10 Hz; power 0.55 W; pulse duration VLP, handpiece R093.

The handpiece is moved in a sweeping manner across the gel surface. If undesirable pain or sensitivity occurs on any tooth (rarely) go to the next tooth. Pay attention not to irradiate two neighboring teeth at the same time. The whole procedure is repeated three times so that every tooth is irradiated for 3 x 20 seconds.

I) Removal of the bleaching gel and color check

When the three-cycle illumination of all teeth has been completed, the gel is removed with an aspirator and the tooth surface is thoroughly rinsed with a water spray. The color is checked with a shade guide and shown to the patient.

J) Re-checking the gingival protection and repeating the procedure

The procedure can be repeated up to 3 times in one appointment if necessary.

K) After-treatment photographs

At the end of the treatment, the teeth are cleaned of the gel, and the gingival protection is removed. The achieved color is checked, compared with the shade guide (VITA B1–C4) and included in the image to serve as a reference point.

Teeth are gently dried. Patients are instructed not to eat or drink colored food for 72 hours (coffee, tea, red wine). Smoking should also be avoided. An appointment is made for a control session after 14 days. If there is need for a second treatment, the interval is 14 days. _

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9. TouchWhite™ is a registered trade mark of Fotona d.d. (www.fotona.com).

Editorial note: The whole list of references is available from the publisher.

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