

(CASE REPORT)



## Laser whitening of a devitalized discolored tooth not associated with the gel containing hydrogen peroxide: A case report

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### Abstract

The color of the teeth is considered an important aspect for having a beautiful smile and improving the aesthetic appearance. Quick teeth whitening has become one of the most requested dental procedures in our society. The laser has been considered the most valuable energy for teeth whitening.

The main advantage of laser whitening is that it can be completed in a single studio treatment and allows you to focus on a single tooth or even a selected part of a tooth. The aim of this study was to evaluate the whitening effect of the 810 nm laser light, without the addition of hydrogen peroxide gel, on a devitalized and dyschromic dental element with aesthetic value.

**Keywords:** Discolored devitalized tooth; Minimally invasive direct photo whitening; Laser whitening; parameters; Pulp

### 1. Introduction

The search for the perfect smile has led to considerable advances in cosmetic dentistry. More and more patients try to improve the appearance of the smile by choosing teeth whitening, which can provide significant cosmetic improvements relatively quickly and at low cost compared to dental veneers [1]. When done correctly, teeth whitening is a safe technique [2]. In discoloured teeth the coloured stains (chromophores) can be present above the enamel surface or inside the tooth structure itself. Stains on the surface can in most cases be removed easily by professional cleaning, for example, by a prophylaxis using a mild abrasive paste or fine flour of pumice. This is done as a clinical step immediately prior to an in-office bleaching procedure. As well as improving the appearance of teeth by increasing the spectral reflection of light, this external cleaning process removes both saliva and polyphenols (such as tannins) on the tooth surface which can inactivate ROS. Surface stains can also be decolourized, rather than removed, and this mechanism explains much of the cosmetic benefit gained by very low strength (0.5%) hydrogen peroxide rinses, paint-on gels, and various oxygen releasing products such [1,2].

For chromophores which reside inside tooth structure, a penetrating action is needed, in the form of either light which is transmitted internally and causes photooxidation and/or the production of ROS, leading to radicals which penetrate readily through the crystallized structure of enamel and dentine [3,4]. Darkening of a single anterior tooth negatively impacts the appearance of the smile. Tooth bleaching is considered a conservative treatment option for darkened nonvital teeth, and, whenever possible, must be considered the first choice of treatment [5]. Discolored devitalized teeth are usually treated with internal whitening in the pulpar chamber [6]. The laser has been considered the most valuable energy for teeth whitening. The main advantage of laser whitening is that it can be completed in a single studio treatment and allows you to focus on a single tooth or even a selected part of a tooth [7]. Other advantages of the laser

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bleaching technique include greater safety and control, as well as the prevention of tissue damage, the reduction of application times and greater patient satisfaction [8].

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## 2. Case presentation

A 43-year-old patient in systemic good health came to our attention due to an aesthetic problem on dental element No. 2.1, due to the dyschromia induced by endodontic treatment (Fig. 1). On clinical examination, the tooth appeared a non-homogeneous yellow color. After the radiographic examination, the possibility of performing external whitening with an 810 nm diode laser instead of the conventional protocol whitening treatment was evaluated, through lingual access to the endodontic space by placing the intra-coronal whitening peroxide. The patient signed the consent form before starting the treatment which was performed in a single session. First, the surfaces of the teeth were cleaned with pumice powder and 3% oxygenated water to eliminate bacterial biofilm and degrease the enamel. The parameters applied to the 810 nm diode laser were 2.5 watts in continuous mode and 320 microns of activated fiber (Fig. 2). The movements of the fiber were lawn-mowing, longitudinally from the incisal edge to the cervical edge for a total of 5 minutes. The enamel surfaces were scanned continuously.

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## 3. Results

After irradiating the discolored tooth with the laser beam for one minute, there was a lightening of the intrinsic pigmentation (Fig. 3), after 5 minutes of laser treatment the devitalized tooth n. 2.1 was more evidently bleached (Fig. 4). The laser 810 nm whitening treatment without hydrogen peroxide gel was effective and very fast in results.



**Figure 1** Dichromic devitalized tooth n 21 before treatment (t0)



**Figure 2** Element 21 during laser irradiation (t1)



**Figure 3** Element 21 one minute after laser activation (t2)



**Figure 4** Post treatment, after 5 minutes of laser bleaching not associated with hydrogen peroxide (t3)

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#### 4. Discussion

In laser whitening the essential elements of light that determine its reaction with the target are the wavelength of the radiant energy (nm) emitted by the laser, the power density of the beam (measured in a square centimeter as the unit area  $W/cm^2$ ), and the temporal characteristics of the beam energy, such as continuous versus pulsed delivery, pulse rate (Hz), and pulse duration. With a pulsed laser, it is more practical to talk about the amount of energy per pulse in Joules ( $1 J = 1 W/s$ ), rather than the average output power in watts. Other useful measures are energy density ( $J/cm^2$ ) and the amount of energy per unit area (fluence). In addition to these factors, there are several other variables that relate to differences in how the laser energy is delivered, such as contact versus noncontact delivery mode, focused versus unfocused beams, and beam diameter [1-8]. Next to the wavelength of the laser, the mechanism of action of the laser is affected greatly by the power of the radiation delivered and the mode of operation. The type of mode influences the dynamics of heating of the target; that is, accumulated heating with continuous wave mode is higher than that with pulsed mode. At low irradiances and/or energies, laser-tissue interactions are either purely optical or a combination of optical effects, photochemical effects, and photobiostimulation. When laser power or pulse energy is increased, photothermal interactions begin to dominate [4,9]. Combining these various points, when choosing a laser wavelength to enhance bleaching efficacy it is of the utmost importance to consider the extent to which light “absorption” (which is both wavelength and target dependant) is needed and when it occurs how much of the laser energy will be converted into heat. The absorption of photons will influence the temperature rise which occurs within the bleaching product, the dental hard tissues, and/or pulp tissues [10].

Basically, the whitening process requires breaking down or transforming the molecules that have stained your teeth. This phenomenon can occur indirectly, thanks to hydrogen peroxide, through the production of radicals and the activation of chemical reactions that cause the degradation of the dye molecule, or directly through the absorption of photons in the molecules of the dyschromia [11]. In teeth whitening, light must be able to penetrate the structures of the tooth (transmission) to remove the chromophores that color it. This process is called photooxidation and direct photobleaching. Due to the high light density, laser light is more efficient in photobleaching than non-laser light [4]. In our study, the 810 nm laser device proved effective in improving the discoloration of a devitalized tooth with direct bleaching. A minimally invasive external whitening of devitalized teeth could in the near future be a routine practice thanks to the laser beam. Laser whitening can therefore be considered a valid alternative to conventional internal whitening in discolored devitalized teeth due to its effectiveness, minimally invasiveness, safety and speed of results obtained for greater patient comfort, moreover this treatment can be considered advantageous for its low costs for both the patient and the dental office as the time spent in the chair has been significantly reduced compared to whitening with hydrogen peroxide gel.

Further studies with more data will be needed to confirm this finding.

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#### 5. Conclusion

The use of an 810 nm wavelength diode laser for teeth whitening has proven effective. The absence of the hydrogen peroxide gel reduces the possibility of side effects. Furthermore, this treatment could avoid aesthetic rehabilitation with ceramic veneers that would involve sacrifice of dental tissue.

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#### Compliance with ethical standards

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*Disclosure of conflict of interest*

Authors declare no conflict of interest.

*Statement of informed consent*

Informed consent was obtained from all individual participants included in the study.

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