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Case Study

Aesthetic Oral Application of Laser for Teeth Whitening and Gums Depigmentation.
Case Series and Description of Operative Technique.

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Introduction

Modern dentistry is increasingly turned towards an esthetic, conservative and minimally invasive sense in order to obtain satisfactory results for both the patient and the operator.

The clinician must frequently face the presence of chromatic alterations (discoloration) of the dental elements and fewer times several pigmentations of gums and oral mucosa. Such chromatic alterations of both hard and soft tissues are often experienced by the patient as disabling, with important repercussions from a psychological point of view and in the life of relationships.[1.2]

Several laser devices with specifical wavelength can be employed in a minimally invasive way to solve the above mentioned aesthetic disease.

Different laser techniques of oral dental and gum whitening, performed by acknowledged authors worldwide will be described in light of most recent and significative scientific literature.

Dental Whitening

Tooth whitening procedures provide a conservative means to improve dental esthetics. Whitening procedures can also be performed as an adjunct to other restorative and prosthetical procedures [20].

Tooth bleaching has been defined as chemically induced whitening due primarily to the effects of hydrogen or carbamide peroxide. Various techniques and concentrations have been proposed in last three decades [20].

The whitening effect that can be obtained following the use of the laser is achieved as a result of a redox process. The laser energy applied splits the hydrogen peroxide (H2O2) into a water molecule (H2O) and an oxygen free radical capable of combining with the molecules of the pigmenting substances, favoring their dissolution.

Modern diode lasers intervene in support of ordinary clinical procedures by simplifying and speeding up the hard tissue whitening procedures, increasing patient compliance with treatment. [2-4]

Studies are reported in which diode lasers with different wavelengths, from 445 to 980 nm, are successfully used. [1-6] Depending on the different absorption coefficients, the parameters of use can undergo variations. In this regard, it is useful to resort to the use of colored whitening gels, so as to reduce the absorption of radiation by the hard tissues of the tooth, instead favoring the selective absorption at the level of the gel, in order to reduce thermal phenomena, potentially harmful at pulp level. [7]

Dental bleaching can be obtained using different means of conduction, as described in most recent clinical laser manuals [16].

Equally unfocused optical fibers, unfocused tips and handles can be used with proper setting and technique depending on clinical situation.

Diode Laser in Gingival Whitening

Gingival hyperpigmentation is mainly related to an excessive deposition of melanin the the basal and suprabasal cell layers of oral epithelium. Gums pigmentation frequently involves cosmetic concerns for patients; appears as a dark grey-brownish color alteration, frequently visible in patients with gummy smile or high smile line20. Although melanin pigmentation of the gingiva is frequently benign, a proper accurate anamnesis and a complete differential diagnosis should be conducted.

The use of different laser sources, with specific methods of application, in the treatment of gingival pigmentation, has been documented by various authors over the last decades [11-14].

Unlike dental whitening procedures, it is a technique that does not involve the use of peroxide and whitening solutions, but is based only on the ablative or selective action of the laser beam.

Most of the techniques foresee a microsurgical removal of the superficial epithelial layers until the basal layer is reached, so as to obtain a reduction of melanocytes. CO2 and Erbium-Yag lasers can be favorably used in this way due to their high ablative capacity.

The recent diode lasers can also be used in ablative mode, benefiting the operator during the procedure thanks to the intrinsic haemostatic capabilities of the instrument, depending on the wavelength used. These techniques, although considered non-invasive, expose the patient to surgical trauma, the presence of a wound in the oral cavity and the removal of a portion of healthy tissue.

Recently some authors 16 have proposed the use of diode lasers with affinity for melanin, in a non-contact and non-ablative modality.

Also known as non-ablative gingival depigmentation of melanin, it represents an innovative and minimally invasive technique with high esthetic value.[11]

The technique involves the selective action of the laser beam at the level of the deeper layers of the oral epithelium, so as to reach the chromophore. Depigmentation is achieved through selective photothermolysis of melanin, without directly damaging the superficial tissue layers. This ensures greater comfort for the patient, with a reduction in symptoms and greater compliance with treatment.

Case Report

Clinical Case 1: Laser Dental Bleaching with Arch Shaped Unfocused Handle.

A 36-year-old healthy female patient underwent complete nonsurgical periodontal hygiene procedures before a laser assisted dental whitening procedure.

A 915 nm NIR diode laser with a specifically designed full arch bleaching handle has been used in combination with a 38% solution of hydrogen peroxide, allowing an improvement of the aesthetic appearance and satisfactory patient reported outcome.

Figure 1 Preoperative view after completion of oral hygiene procedures. (A3 Vita shade.)

Figure 2 Soft tissues isolation throught Kerr Optiview retractor and liquid dental dam. 38 % Hidrogen Peroxide is properly applied on teeth surfaces (Mentadnt White Beauty Professional Medical Whitening Treatment. Unilever.)

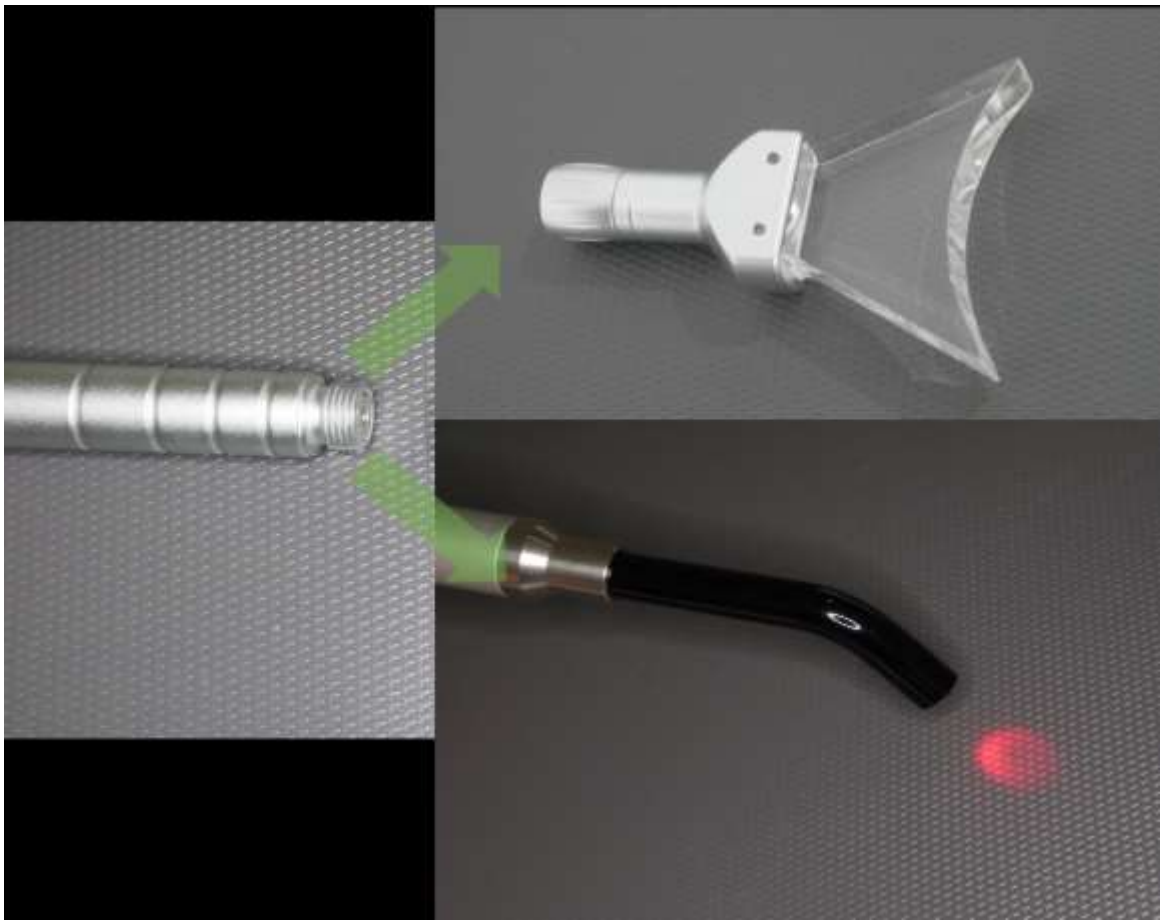

Figure 3 Universal handle for 915 nm diode laser. A screwed universal connector can host both intraoral single tooth bleaching tips or arch shaped tips for full arch bleaching. (8853; 88Dent; Pero - MI; Italy)

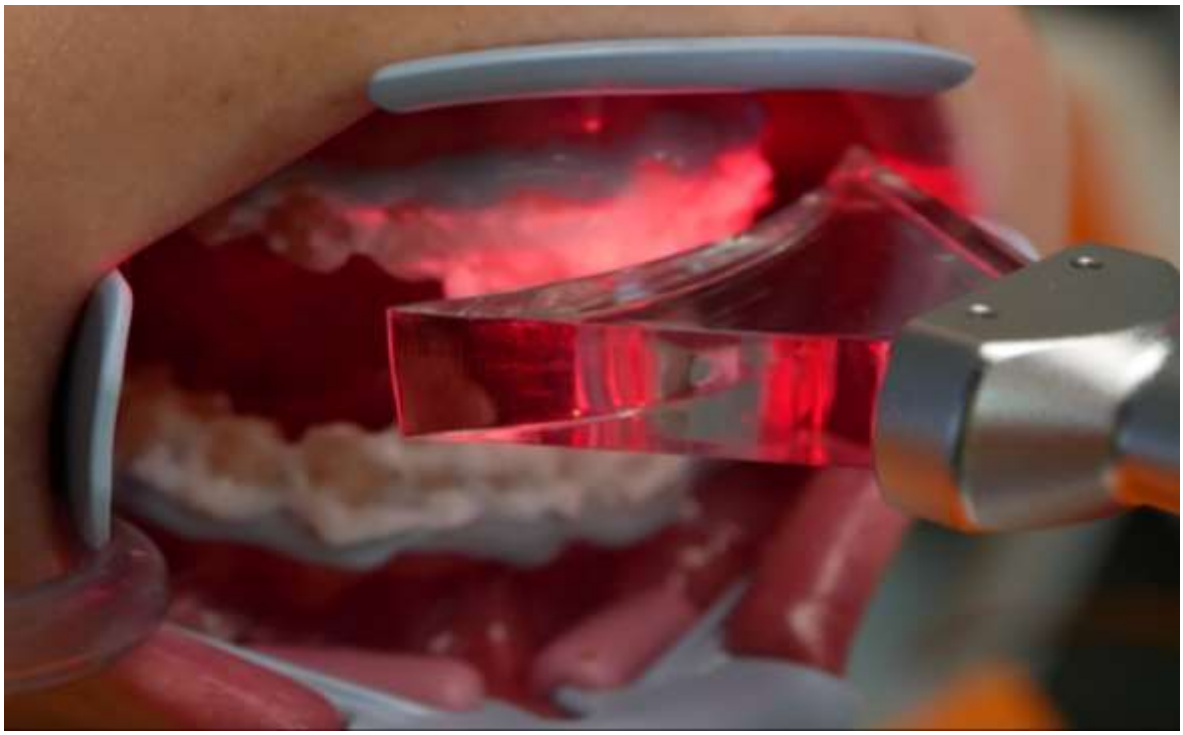

Figure 4 Full arch bleaching with 915 nm diode laser (2.4-4W C.W. 8-10 min)

Figure 5 Post-treatment intraoral view. (A2 vita shade)

Figure 6 Post-treatment extraoral view.

Clinical Case 2

A 26 years old healthy male patient was referred for aesthetic global oral tissue improvement.

The oral tissue examination revealed the presence of deep gingival pigmentation, plaque-related gingivitis and teeth discoloration. Complete patient history and anamnesis was collected. Due to early onset and data collected, pigmentations were classified as physiologic/racial pigmentations, according to most recent classifications.[21]

Patient was listed forcomplete periodontal hygene procedures, teeth withening and gum depigmentation through laser assisted procedures.

Treatment Plan Outline

Gingival depigmentation was performed using a 980 nm NIR diode laser using a direct contact technique.

Treatment alternatives are listed as follow:

- Surgical Scalpel for soft tissue depigmentation
- LED light for bleaching or chemical bleaching without light activation
- Home bleaching
- Use of whitening tooth past

Following precautions were adopted during the procedure:

- Care must be taken because the penetration depth of diode laser is 6 mm)
- Minimal power parameter, time interval to allow thermal relaxation and control of carbonization tissue and optic fiber would all reduce the risk of primary and secondary damage
- For teeth whitening avoid thermal damage for the pulp by make relaxation time between each cycle
- For gingival depigmentation care for gingival contour and interdental papillae
- Laser safety protection by eye glass for patient and all teamwork with suitable optic density that compatible with diode laser 980 nm
- Air suction during gingival depigmentation and tissue ablation to avoid smoke risk inhalation

As in all other cases a complete Informed Consent was presented:

- The treatment plan was fully explained to the patient and all associated risk outline
- A written consent form was signed by the patient in the presence of a witness
- The consent form was retained in the treatment notes:

Scaling and polishing using ultrasonic scaler and low speed headpiece was performed prior aesthetic dental and gum bleaching.

Bleaching of anterior upper and lower teeth was completed using 980 nm diode laser

Gingival depigmentation was performed using a 980 nm NIR diode laser using a direct contact technique.

Postoperative healing was free of any complications, including unattended bleeding and scars. Patient follow up was performed every two weeks for 60 days and with a delayed one year follow up.

Figure 7 Preoperative view. Diffuse colour alterations and gingival pigmentations can be observed. (A4 Vita Shade.)

Figure 9 Application of H2O2 bleaching solution

Figure 10 Diode laser application with "tooth by tooth" technique. 20-30 sec , 2W CW for every tooth.

Figure 12 Microsurgical direct laser technique is adopted for soft tissue depigmentation. Soft tissue is treated with 980 nm diode laser (Wiser ; Lambda spa Brendola ,VI, Italy) with a "layer by layer" removal through 400 □m activated optical fiber, until ablation of pigmented soft tissue is reached.

Figure 13 Delayed postoperative view. 30 days after completion of cosmetic and microsurgical laser procedure. (A2 Vita shade).

Clinical Case 3

Pigmentation of the gingival and alveolar mucosa.

Description of the operative technique.

Following the induction of local anesthesia by infiltration, optic fibers are generally not activated, in non-contact mode, maintaining a constant distance of about 1 mm from the surface of the pigmented tissue. With slow centrifugal movement, i.e. linear, the pigmented area is treated until a chromatic change towards white or light gray is obtained. It usually takes a few seconds of application for every square millimeter. Depending on the wavelength used, it is possible to apply nominal powers between 1-2 W CW (for 445 nm), 2-3 W (for 808-915 nm) and 3-3.5 W CW (for 980-1064 nm). The treatment can be repeated after about 28 days, in response to the cell turnover time, depending on the clinical situation.

Postoperative healing was free of any complications, including unattended bleeding and scars. Patient follow up was performed every two weeks for 60 days and with a delayed one year follow up.

Figure 14 Initial status of the patient of Asian ethnicity (M; 18 a) with widespread gingival racial pigmentations. Pigmen- tations cause esthetic alterations with an impact on the psychology of the young patient. From textbook “Manual of diode laser in dentistry and stomatology”. Emanuele Ruga, Marco Garrone, Raffaele Michele Calvi. p.71-79 EDRA 2021”

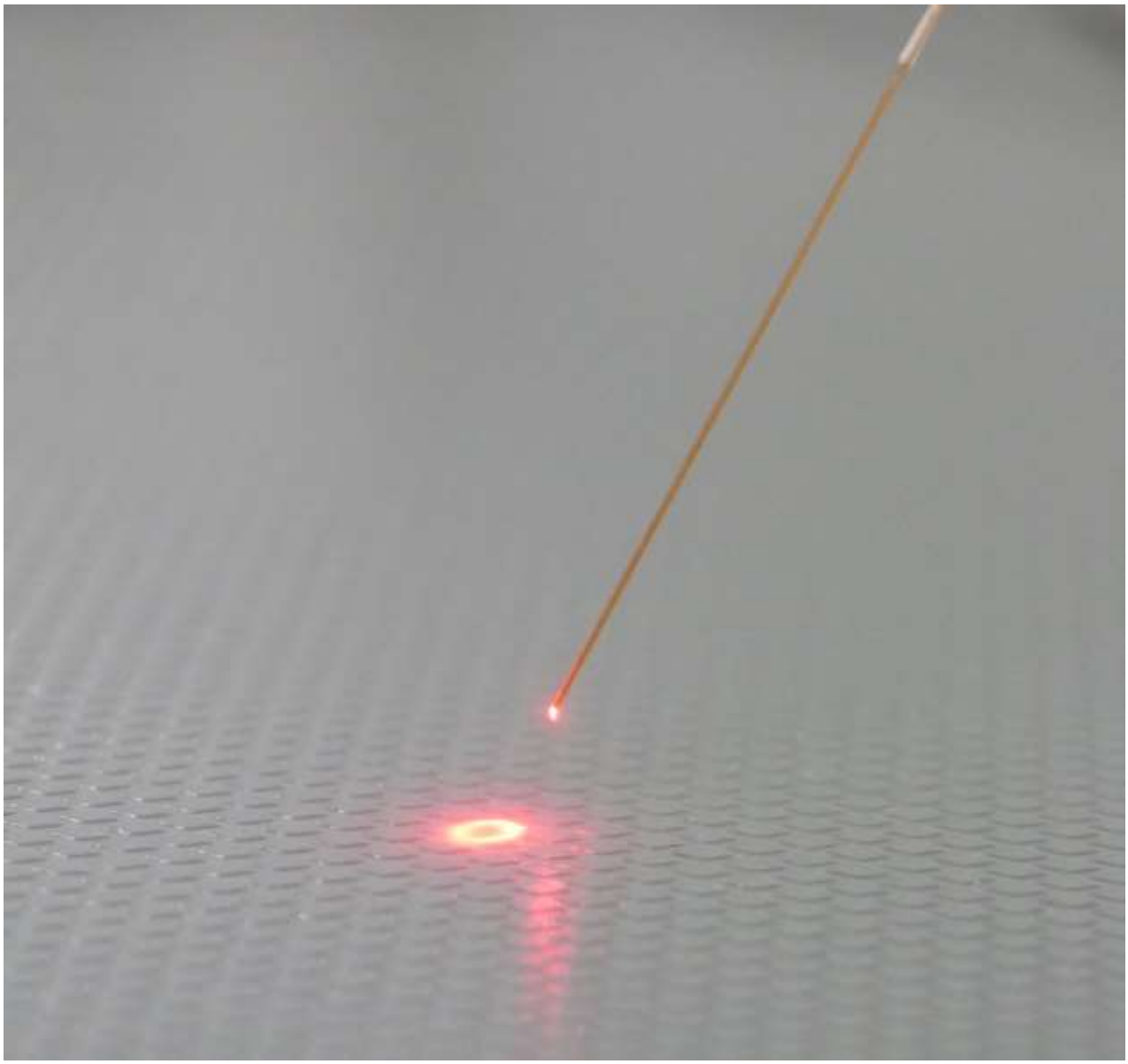

Figure 15 Unfocused Unactivated (NA) optical fiber is applied in non contact modeas shown in the picture. Generally a mean distance of 1 mm is mantained constantly from oral ephytelium without touchin the oral soft tissue.

Figure 16 915λ nm diode laser (Pocket Laser, Pero , MI Italy) is used in a non contact focused mode(2.5WCW, 400 nm NA fiber Selective photothermolysis of melanin starts an immediate color change of the pigmented gingival islands which turn from brown to light gray-white.). From textbook "Manual of diode laser in dentistry and stomatology" . Emanuele Ruga, Marco Garrone, Raffaele Michele Calvi . p.71-79 EDRA 2021"

Figure 17 Clinical result 60 days after treatment. A significant reduction in gingival pigmentations is appreciated, with satisfaction and high compliance of the patient. From textbook "Manual of diode laser in dentistry and stomatology" . Emanuele Ruga, Marco Garrone, Raffaele Michele Calvi . p.71-79 EDRA 2021"

Clinical Case 4

A 58-year-old healthy male patient underwent complete nonsurgical periodontal hygiene procedures before a laser assisted dental whitening procedure.

A 915 nm NIR diode laser with a specifically designed intraoral angled bleaching / biostimulation tip has been used in combination with a red colored 40% solution of hydrogen peroxide, allowing an improvement of the aesthetic appearance and satisfactory patient reported outcome.

Figure 18 Extraoral preoperative view. Picture is taken immediately after completion of oral hygiene procedures. A3,5 VITA shade.

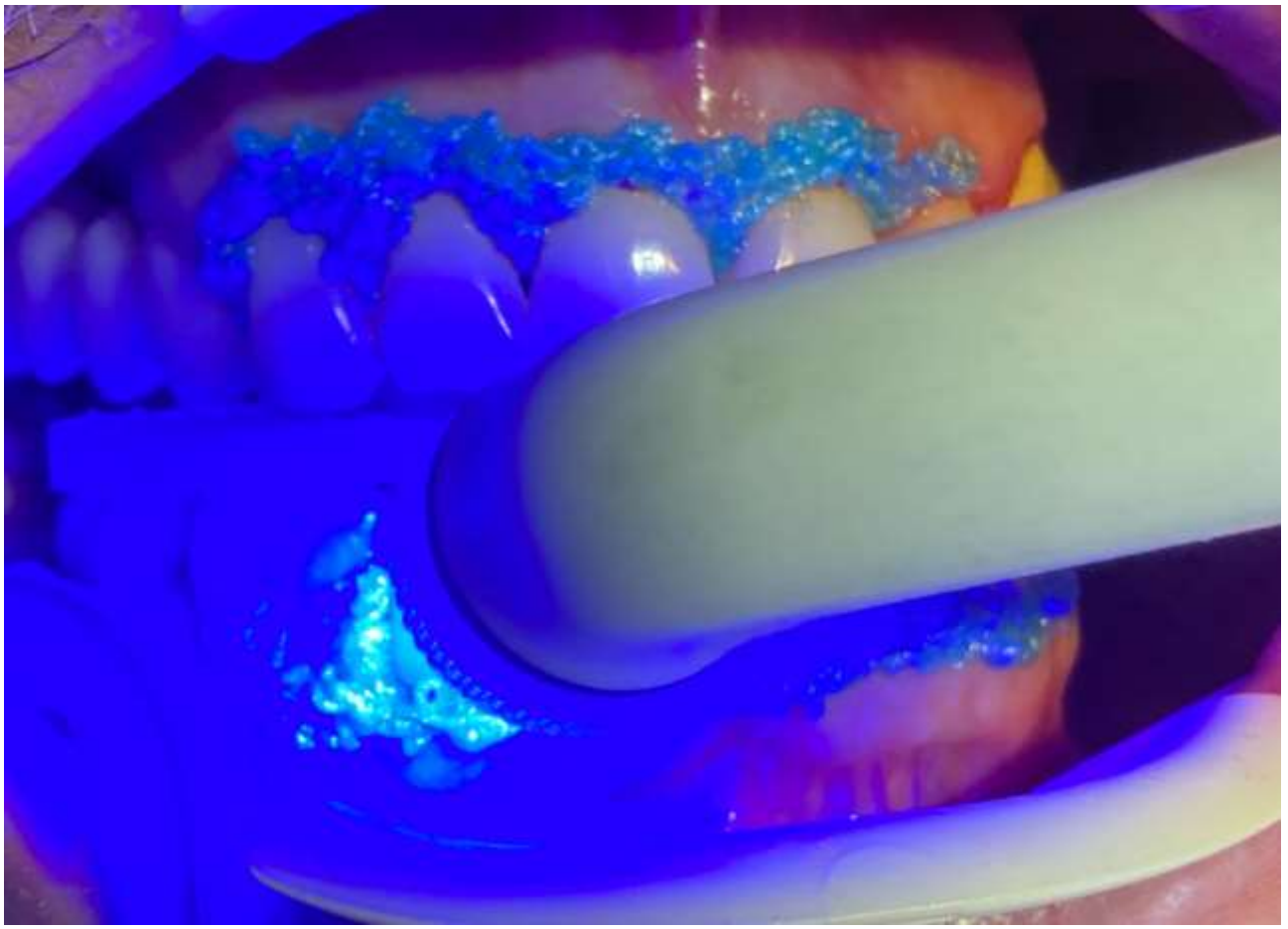

Figure 19 Liquid dental dam polimerization.

Figure 20 Activation of Hidrogen Peroxide 40 % solution. (Opalescence boost. Ultradent Italia, Corsico,MI, ITALY)

Figure 21 Extrusion and application of red coloured hidrogen peroxide. (Opalescence boost. Ultradent Italia, Corsico,MI, ITALY)

Figure 22 Settings of 915 nm diode laser unit . (Pocket Laser 88Dent 8853 Pero,MiI, Italy) A specific software guides clinician through proper clinical setting. 2.5 W CW are used for 30 sec. in tooth by tooth technique. Laser unit 's touch display is properly protected with a disposable adhesive coverbefore every use.

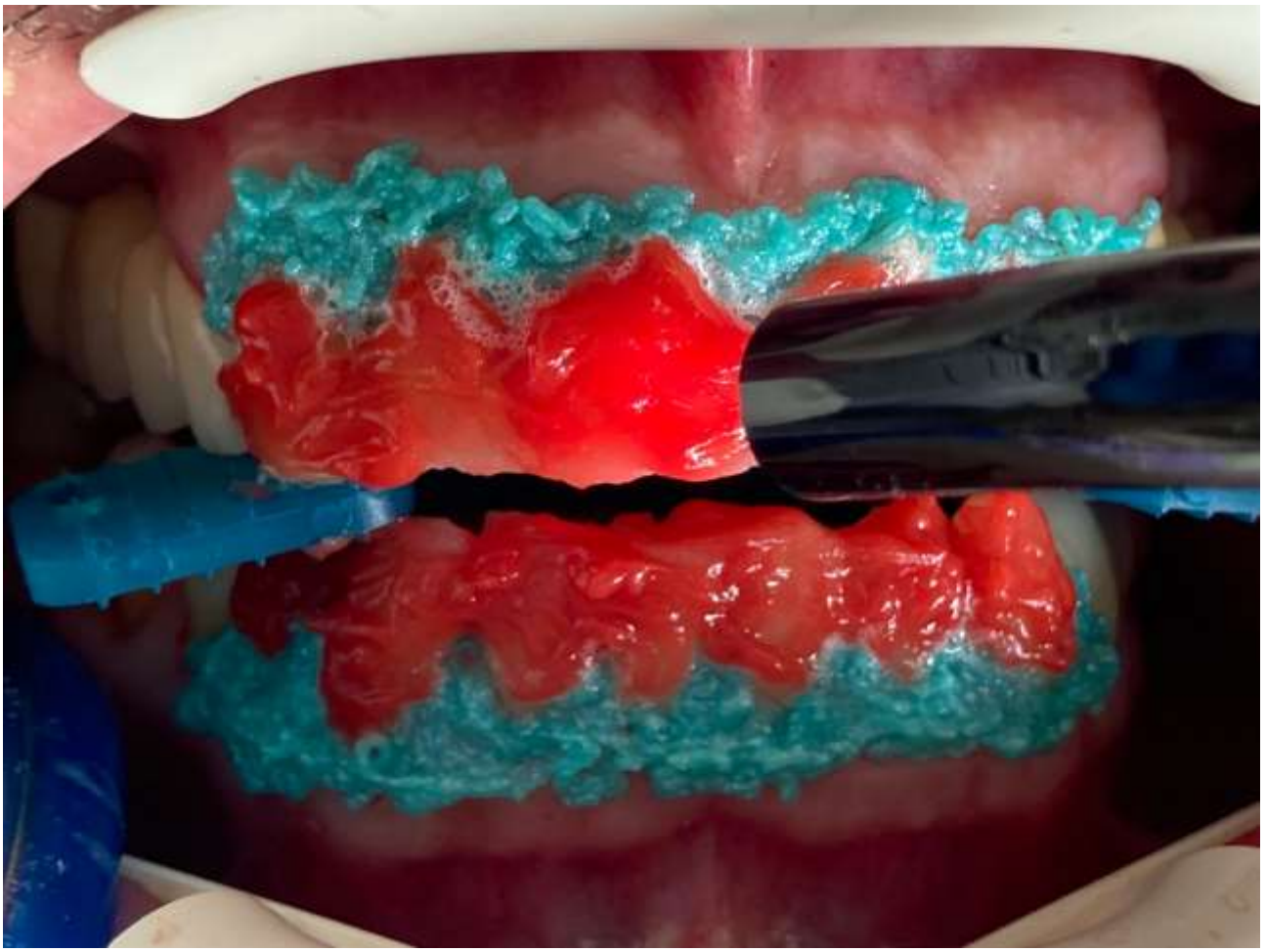

Figure 23. Intraoral tip for bleaching and biostimulation. 2.5 W CW are used for 30 sec. in tooth by tooth technique

Figure 24 Postoperative view. (A2 Vita shade)

Case 5

A 37 years old healthy female patient underwent CO2 laser microsurgical treatment for gums depigmentation.

Patient was treated using a 2W pulsed mode CO2 laser unit (10600 nm wavelength) (COSMO PULSE 25 ; CHOYANG MEDICAL INDUSTRY LTD. KOREA) in one single session (estimated time 45 minutes for upper and lower arch) allowing an improvement of the aesthetic appearance and satisfactory patient reported outcome.

Postoperative healing was free of any complications, including unattended bleeding and scars. Patient follow up was performed every two weeks for 60 days and with a delayed one year follow up.

Figure 25 Extraoral preoperative view

Figure 26 Intraoral preoperative view of upper and lower gums and oral mucosas. Dark brownish pigmentation can be observed in both dental arches , affecting patient aesthetic and psicological

Figure 27 Immediate postoperative view after Co2 with 2 W pulsed emission. Laser application. (COSMO PULSE 25; CHOYANG MEDICAL INDUSTRY LTD. KOREA) Time of intervention has been estimated in 45 minutes for both upper and lower arches in one single session.

Figure 28 Postoperative view 60 days after laser application.

Figure 29 Postoperative view 60 days after laser application.

Discussion

Dental Whitening

Diode laser of 940 nm it is reported to be an effective adjunctive tool for reducing tooth sensitivity originated from high concentration H2 O2 bleaching gel**[**17**]**.

Laser-bleaching with 810-, 940- and 980-nm wavelengths of NIR (Near InfraRed) diode laser has an efficacy similar to that of conventional bleaching but in a shorter period.

On the other hand, no difference was noted between different laser wavelengths in terms of bleaching efficacy.**[**18**]**

In this case series, diode lasers were used as a complement to teeth whitening treatment, confirming that they do not cause post-operative ipersensitivity for patients.

The used bleaching system achieved significant shade change compared to baseline photography.

Several clinical trials and literature reviews suggests that laser-bleaching techniques have better efficacy on tooth surface which resulted in lesser sensitivity and adequate improvement of tooth color and brightness value, at the same time effectiveness of the treatment is same as that of the normal procedure but frequently with reduced operative time [19].

Diode Laser in Gingival Whitening

The NIR 915 nm diode laser has shown a good affinity towards melanin, allowing the non-ablative whitening treatment of the gingiva to be performed safely, without side effects.

Using the 980 nm diode laser it was possible to remove the hyperpigmented gingiva layer by layer, without undesirable effects for the patient, with excellent control of hemostasis and obtaining excellent intraoperative visibility. However, this technique, compared to non-ablative, is more invasive.

Conclusions

CO2 laser still remain a valid and versatile unit for surgical and aesthetic oral purposes, capable of performing gum depigmentation with a predictable and satisfactory minimally invasive action.

NIR diode lasers with 980 nm wavelength and especially the 915nm wavelength prove to be versatile and safe tools, that allow the clinician to perform whitening treatments in a minimally invasive way on both the hard and soft tissues of the oral cavity.

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