Journal of Lasers in Medical Sciences

J Lasers Med Sci 2022;13:e41

Case Series

http://journals.sbmu.ac.ir/jlms

doi 10.34172/jlms.2022.41

Gingival Melanin Depigmentation Using a Diode 808-nm Laser: A Case Series

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Received: November 2, 2021
Accepted: July 18, 2022
Published online September 29, 2022

Abstract

Introduction: Gingival hyperpigmentation is caused by an increase in the amount of melanin production or the number of melanocytes in the epithelium, which can impair smile esthetics. The current study aimed to report the experience of using a diode laser for gingival depigmentation of three different patients.

Case Presentation: Three adult patients are presented with hyperpigmentation in labial gingivae of both jaws. The depigmentation was done using a diode laser at a wavelength of 808 nm, fiber diameter of 300 µm, and power of 1 W and in continuous mode. All three patients showed proper resolution of hyperpigmented areas in short- and long-term follow-up sessions. However, degrees of recurrence were noticeable in two cases.

Conclusion: The 808-nm diode laser can be utilized safely and efficiently in gingival depigmentation, resulting in an acceptable cosmetic outcome.

Keywords: Hyperpigmentation; Laser therapy; Diode laser; Melanocytes; Cosmetic dentistry.

Introduction

Gingival hyperpigmentation is the presence of excessive melanin in the basal/suprabasal layer of epithelium due to an increase in the amount of melanin production or in the number of melanocytes.[1] Melanocytes are specialized cells with multiple dendritic processes and cytoplasmic brown granules. These cells originated from the neural crest ectoderm migrate to various body sites such as the skin, mucosa, and eyes.[2] The number of mucosal melanocytes is relatively similar to that of skin despite the fact that mucosal cells are less active.[3] Hyperpigmentation may be caused by drugs, metals, genetics, endocrine disorders, ultraviolet rays, inflammation, malignancies, tattoos, and tobacco usage.[4,5] Moreover, hyperpigmentation may be the manifestation of systemic diseases like Kaposi's sarcoma and Peutz Jeghers syndrome.[6] The hyperpigmented gingiva may not cause medical complications by itself, but it may cause esthetic concerns, especially when it is visible in the smile zone.[7]

There are two main approaches to resolving this issue: removing or masking the hyperpigmentation.[8] Masking can be accomplished through gingival grafting, but if removal is desired, such options as scalpel surgery, bur abrasion, electrocautery, cryosurgery, radiosurgery, chemical cauterization, and laser ablation are available.[9-12]

The laser production mechanism stands on two key components: an energy source (e.g., lamps, electrical current or other lasers) alongside an optical resonator (a tube containing a medium surrounded by mirrors).[13] The energy source supplies the required energy to excite electrons. Following the return of the electrons to their primary state, photons of a particular wavelength are emitted.[14] The medium is the component that determines the properties (e.g., wavelength) and identification of the laser. Common mediums are elaborated as diode, CO_2, Nd:YAG, Er:YAG, KTP, and so on.[13]

Different host tissues absorb lasers of specific wavelengths; for example, the melanin located inside melanocytes absorbs lasers at a wavelength of 351 to 1064 nm, leading to an increase in intracellular temperature and pressure. Consequently, cell destruction occurs, resulting in the production of vapor and tissue debris.[15]

The CO_2, Er:YAG, Nd:YAG, and Diode lasers are broadly utilized in gingival depigmentation.[6,7,16] Choosing lasers over other therapeutic modalities lets an operator have improved hemostasis and better vision during surgery and allows the patient to experience less pain, bleeding, infection, edema and recurrence, and better healing.[17-19] Apart from the advantages, laser depigmentation requires huge special pieces of equipment, costs more, and may harm surrounding gingival tissue and the supporting bone if misapplied.[20]

Among various lasers available, the diode laser can cause the depigmentation procedure to be performed

Please cite this article as follows: Esmaeili S, Shahbazi S, Asnaashari M. Gingival melanin depigmentation using a diode 808-nm laser: A case series. *J Lasers Med Sci.* 2022;13:e41. doi:10.34172/jlms.2022.41.

efficiently, with patients experiencing low levels of pain and well-controlled bleeding.[21] Furthermore, the repigmentation rate following the diode laser has been found to be lower than that of other lasers, resulting in better long-term stability of the acquired gingival color.[22] Regarding esthetic outcomes, the diode laser has been reported to attain more pleasing results at a lesser chair time compared to other lasers.[23]

Reporting three cases referred to the Dental School of Shahid Beheshti University of Medical Sciences, this study aimed to share the experience and outcome of using an 808-nm diode laser in gingival depigmentation.

Case Presentation

Three patients were referred to the Laser Department of Shahid Beheshti Dental School:

Case 1

The first patient was a 26-year-old female with fair skin. Her chief complaint was "dark-colored gum in the anterior area", which had been apparent since childhood and remained unchanged since then. She made no mention of any specific symptom or noteworthy item in her medical history and denied taking any medications. She had not received any previous treatment for the stated chief complaint. Melanin hyperpigmentation of scores 2 and 3 was observed in the labial gingiva of the upper and lower jaws respectively, according to the Dummett–Gupta Oral Pigmentation Index (DOPI)[24] (DOPI is demonstrated in Table 1). To make a more accurate assessment of the treatment effectiveness, we selected equal-sized squares within the pre- and post-operative photographs using Adobe Photoshop software version 2019 (Adobe Inc., United States). The mean red, green, and blue (RGB) values of the aforementioned areas were then compared (Table 2). The lesions were extended as two short ribbons in the maxillary gingiva and one long continuous ribbon in the mandibular gingiva, resulting in Hedin Melanin Index (HMI)[25] degrees of 3 and 4 respectively (Table 3). The pigmentation involved both keratinized and non-keratinized gingiva. The only noticeable items in the diagnostic panoramic radiograph were cervical caries in teeth #22 and #23, confirmed by clinical examination. After ruling out other etiologies, it was diagnosed as physiological melanin hyperpigmentation. Periodontal inflammation was also evident based on the presence of bleeding on probing (BoP), which could have been caused by improper veneers. Next, a consent form explaining the potential recurrence of pigmentation after laser therapy and the possible need for further therapy sessions was signed. Alternative treatment modalities (scalpel surgery, bur abrasion, etc) were also discussed. Due to the patient's preference, the depigmentation was planned to be performed individually on each jaw at a 6-month interval. Before starting the procedure,

Table 1. Dummett-Gupta Oral Pigmentation Index (DOPI)

Score	The Intensity of Pigmentation
0	No pigmentation (pink gingiva)
1	Mild pigmentation (light brown gingiva)
2	Moderate pigmentation (medium brown / mixed pink and brown gingiva)
3	Heavy pigmentation (deep brown / blue-black gingiva)

Table 2. RGB Values of Cases at Three Different Time Points

Patient	Mean (±SD) of RGB Values		
	Preoperatively	One-Week Follow-up	6-Month Follow-up
Case 1	100.35±29.65	131.43±50.30	129.08±36.03
Case 2	117.12±25.18	151.23±36.40	140.64±37.35
Case 3	99.66±36.90	139.86±44.05	140.51±32.32

Table 3. Hedin's Classification

Degree	The Extension of Pigmentation
0	No pigmentation
1	Isolated (only 1 or 2 pigmented interdental papillae)
2	Numerous (more than 2) pigmented interdental papillae
3	One or more short continuous ribbons
4	One long continuous ribbon covering the intercanine area

safety goggles were applied for both the patient and the operator, and a 0.2% chlorhexidine (Najo Co., Tehran, Iran) rinse was done to decrease the oral bacterial load. Then, local anesthesia was achieved using 1.8 mL of lidocaine HCl 2% with epinephrine 1:80 000 (Darupakhsh Pharmaceutical Mfg. Co., Tehran, Iran) through the infiltration technique in the maxilla. With the suction tip placed, the irradiation was done using a diode laser (D5-Doctor Smile®, LAMBDA Scientifica, Vicenza, Italy) with the following settings: wavelength of 808 nm, power of 1 W, fiber diameter of 300 µm, total energy of 180 J, and energy density of 4 J/cm^2. Also, laser irradiation was performed in continuous mode for a 3-minute period. The pigmented area was divided into vertical rows, irradiated from one side to another. The laser was applied in contact mode and at a 45-degree angle to the tissue, avoiding damage to the neighboring teeth. The brushing motion was focused on pigmented spots, moving from the attached gingiva towards the free gingiva without needing an air cooling system. Debris was removed using gauze soaked in normal saline. No periodontal dressing was applied, and the patient was provided with necessary precautions, such as brushing her teeth with a soft brush for the next week and avoiding smoking, alcohol, acidic or spicy foods, and beverages. A twice-daily wound dressing gel (Stratamed®, Stratpharma AG, Switzerland) and twice-daily 0.2% Chlorhexidine rinse were also prescribed for home care until the next visit. Using the visual analogue scale (VAS),[26] the patient perceived her experienced pain during the operation by score of 0 (VAS pain assessment

is available in Table 4). The patient was advised to use over-the-counter analgesics (e.g. ibuprofen 400 mg tablets) if necessary. The one-week follow-up showed proper but incomplete healing and the patient scored the postoperative pain by 1. Despite a few remaining brown spots, the 6-month follow-up session revealed almost complete healing and pink color of treated sites (DOPI score = 1, HMI degree = 1). Mandibular depigmentation was done in this session and the patient was satisfied with the outcome in the maxilla, stating that she had gained more self-confidence (Figure 1 and Figure 2).

Case 2

The second patient was a male aged 33 years and of a Caucasian race. He stated his chief complaint as "the black colored gum has impaired my smile". He described that the pigmentation had been present since his childhood but intensified after the onset of smoking tobacco. The only significant item in his history was ten years of heavy smoking and no regular usage of drugs. No previous actions had been taken to resolve the pigmentation concern. The HMI degree was 4 in the maxillary gingiva and 3 in the mandibular gingiva, with a DOPI score of 2 in the former and 3 in the latter. Both keratinized and non-keratinized gingivae were hyperpigmented. The diagnostic panoramic radiograph showed no important item. Based on the mentioned evidence, the diagnosis was physiologic hyperpigmentation. Periodontal status was healthy and free of any inflammation. It was planned to treat maxillary and mandibular hyperpigmentation separately in two sessions. The pre-, intra-, and post-operation procedures were carried out as described in case 1. For intraoperative pain, the patient reported a VAS score of 1. After one week, adequate healing had occurred and the mandible was treated in the same manner. The patient gave a score of 0 for postoperative pain. After 6 months, degrees of repigmentation were evident in both jaws, mainly in the mandibular gingiva (DOPI score = 1, HMI degree = 1). The patient reported a high level of satisfaction with the initial results and was eager to retreat repigmentated sites (Figure 3).

Case 3

The third patient was a 25-year-old fair-skinned male with the chief complaint of "discolored gum and the space between anterior teeth". He described the pigmentation as congenital, without any noteworthy item in his medical history. He denied any regular medication usage and previous treatment of the chief complaint. The examination showed melanin hyperpigmentation with a DOPI score of 2 in the maxilla and 1 in the mandible, extended with an HMI degree of 4. The pigmentation was spread through both keratinized and non-keratinized gingivae. Moreover, a 3-mm diastema was evident between central incisors, caused by high attached labial frenum. The panoramic view did not contain any notable items. According to evidence, gingival discoloration was diagnosed as physiologic melanin hyperpigmentation. No gingival inflammation was seen, making the periodontal

Table 4. The Visual Analogue System for Pain Assessment[a]

Score	The Intensity of Pain
0 mm	No pain
1–30 mm	Mild pain
31–60 mm	Moderate pain
61–100 mm	Severe pain

[a] It consists of a horizontal line of 100 mm long, with the "no pain" label on zero point and the "unbearable pain" label on 100 mm point. The patient places a mark on the scale, describing the intensity of experienced pain.

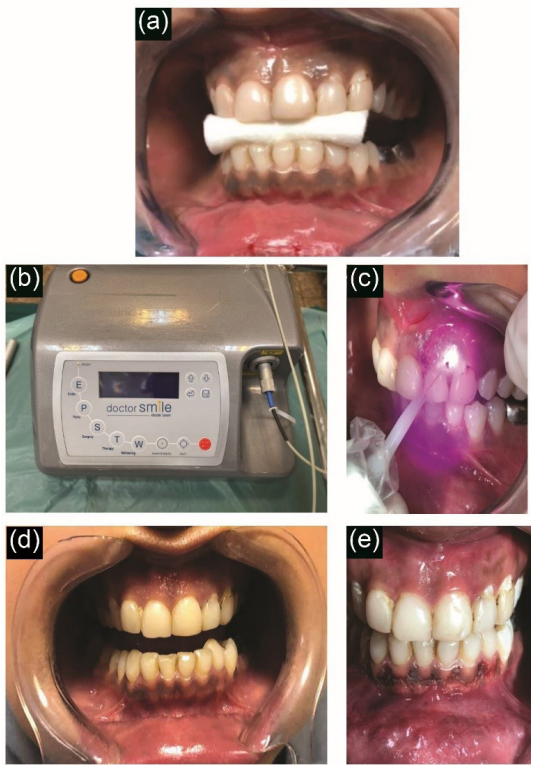

Figure 1. Case Report 1 (a) pretreatment view (b) D5-Doctor Smile diode laser (c) intra-operative view (d) one-week follow-up view (e) 6-months follow-up after maxillary depigmentation and the immediate post-operative view of mandibular depigmentation

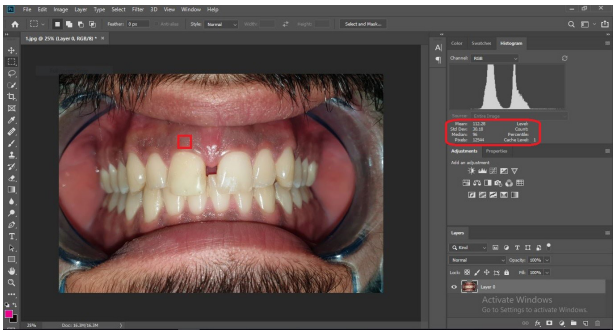

Figure 2. Analysis of RGB Values Within Equal-Sized Squares Using Photoshop Software

Figure 3. Case Report 2 (a) pretreatment view (b) immediate maxillary post-operative view (c) immediate mandibular post-operative view (d) one-week follow-up view (e) 6-months follow-up view

status healthy. Laser depigmentation and frenectomy were planned to be done in a single session. The depigmentation procedure was the same as that in the two previous cases, and mandibular anesthesia was obtained through the infiltration technique. The frenectomy was performed with the same laser properties, but the power was increased up to 2 W due to the superiority of fibrotic tissues in the frenum. The patient chose a score of 2 on the VAS for intraoperative pain. In the one-week follow-up session, the treated sites were healed as desired and the postoperative pain was scored 1. Six months later, complete healing and favorable esthetics were achieved (DOPI score = 0, HMI degree = 0) and the patient was delighted with the outcome (Figure 4).

Discussion

Hyperpigmented gingival tissue can compromise a patient's smile. With a prevalence of up to 89%, many patients suffering from esthetic problems caused by gingival hyperpigmentation seek cosmetic treatments.[27] It is worth mentioning that the demand for gingival depigmentation is higher in patients with higher degrees of the gingival show.[28] Hyperpigmentation can nowadays be treated through scalpel surgery, cryosurgery, gingival grafting, laser depigmentation, and other methods. Cryosurgery causes extreme swelling and tissue destruction with difficulty in depth control.[29] On the other hand, finding a proper donor site that matches the destination site in color makes gingival grafting very challenging.[30] According to many authors, blade surgery is still the gold standard method for depigmentation. However, disadvantages like more post- and intra-operative bleeding, less comfort, and more edema may persuade some clinicians to choose other modalities

Figure 4. Case Report 3 (a) pretreatment view (b) immediate post-operative view after maxillary and mandibular depigmentation (c) one-week follow-up view (d) 6-months follow-up view

like laser depigmentation. Laser depigmentation has advantages such as reduced infection risk and improved wound healing.[3] Accelerated healing is the result of a laser stimulating collagen synthesis and epithelialization.[31] Also, the bactericidal effect of a laser prepares a sterile environment with a minimum risk of infection.[32]

Diode lasers are broadly utilized in modern dentistry. The wavelength of the diode laser ranges from 800 to 1000 nm, approximately. In this spectrum, melanin and hydroxyapatite have the highest and lowest absorption respectively.[33] Diode lasers, due to their high melanin absorption, can be used in depigmentation with minimal risk to dental structures. On the basis of the literature, using a diode laser is a safe and effective depigmentation method with less anxiety and improved outcomes for the patient.[20,34,35] However, caution should be taken to avoid bone exposure or gingival fenestration.[20] CO_2, Er:YAG, ErCr:YSGG, alexandrite and several other lasers have been used in studies for gingival depigmentation, but the diode laser has advantages such as greater efficiency, requiring less time, and enhanced coagulation.[36-38] Moeintaghavi et al conducted a research study to compare the efficacy of CO_2 and diode lasers. At the 6-month follow-up, the diode laser produced significantly more pleasing esthetic results.[23] Jnaid Harb et al compared the efficacy of diode and Er: YAG lasers in gingival depigmentation. Both lasers produced satisfactory results with no significant difference in esthetics but significantly lower pain and better hemostasis via the diode.[21] In another study, Altayeb et al reported comparable clinical results following the application of Er,Cr: YSGG and diode lasers.[22]

Our findings confirm that the 808-nm diode laser with a power of 1 W improves both patient's and operator's comfort while causing the least amount of intra- and post-operative pain. The ability of a laser in sealing blood vessels and blocking nerve endings is the likely reason for reduced bleeding and less pain through laser ablation compared to other modalities.[39] Using high-power diode lasers leads to enhanced hemostasis and less post-operative discomfort. When melanin molecules absorb

the energy emitted by laser photons, the temperature rises up to 150 degrees, which causes coagulation.[40] Although gingival laser depigmentation does not necessarily need local anesthesia,[41] we used Lidocaine HCl 2% with epinephrine 1:80 000 as a vasoconstrictor to achieve reduced intra-operative bleeding and patient's anxiety.

Lasers can be used in either a contact or non-contact mode. Nd: YAG and diode lasers allow the operator to use them in contact mode, which provides benefits such as the tactile sense. They should, however, be used with feather touch strokes, and they should not dwell on one area for an extended period of time, as this may cause damage in deeper layers. Erbium family, CO_2, and modern super-pulsed diode lasers, on the other hand, can be used in non-contact mode. This mode puts patients in a more comfortable situation during the procedure by eliminating the scraping sensation despite the fact that this method necessitates a high level of operator precision.[16]

When complete elimination of active melanocytes from the basal/suprabasal layer of the epithelium is not achieved, the migration of remaining cells from neighboring tissues to the laser-treated site is expected, resulting in the recurrence of melanin pigmentation.[42,43] The rate of repigmentation varies depending on several factors including the utilized treatment modality, number of irradiation sessions, and tobacco usage.[44] Some studies have found that scalpel surgery has a lower recurrence rate than laser ablation,[19,45] while there are studies that state laser therapy results in an equal or even lower repigmentation rate.[27,46] Abduljabbar et al recorded no recurrence of hyperpigmented areas in patients receiving more than one session of laser therapy in a 12-month postoperative period.[44] We noticed mild recurrence in the first and second patients, the latter of whom was a heavy smoker. Current literature confirms that continuing smoking would accelerate the recurrence of pigmentation.[7] Other reasons that may call the superiority of lasers into question are ulcerations and gingival recession (specifically in thin periodontium), thermal damage to the underlying bone or pulp tissues, and higher costs.[20,44]

The absence of histological investigations was a limitation of this study.

Conclusion

Based on our findings, we can conclude that the diode laser can be used safely and effectively in gingival depigmentation, resulting in an acceptable esthetic outcome. Longer-term studies, on the other hand, are required to determine the efficacy of the diode laser in gingival depigmentation.

Conflict of Interests

The authors report no conflict of interest.

Ethical Considerations

All three patients signed consent forms describing the treatment success and recurrence rate. The possible need for further depigmentation sessions was also mentioned.

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