

Evaluation of Gingival Pigmentation Treatment Efficacy Using 980 Nm Diode Laser

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Introduction: Pigmentation is associated with the production of melanin by melanocytes, which is a physiological state in the body. It makes an unpleasant appearance especially for those who have high aesthetic demand. Among different methods, lasers have many advantages in dentistry. Evaluation of gingival pigmentation treatment efficacy using 980 nm diode laser is the purpose of this study. **Material and Methods:** 24 patients were qualified for inclusion in the study. Depigmentation was performed using a diode laser. The size of the pigmentation was measured by AutoCAD software before the intervention, 1, 3, and 6 months after the intervention in each patient. Data were analyzed using SPSS software (v.22), Paired t-test, Smirnov-Kolmogorov, and Friedman tests. **Results:** The results demonstrated that the area and circumstance of the pigmentation significantly reduced after laser therapy. Also, repigmentation rate evaluation demonstrated that the rate has not changed in the first, third, and sixth months of follow up periods. **Conclusion:** The outcomes demonstrated that 980 nm diode laser is effective in treating gingival pigmentation as well as restoring beauty and comfort to the patient.

Keywords: Dentistry; Gum Pigmentation; Laser; 980 nm Diode

Introduction

Gingival pigmentation is a physiological state and is not considered a pathological issue; however, for many, it's problematic especially in patients with a high smile line (gummy smile) and for patients with high aesthetic demands. Pink gingival coloration is considered to be more beautiful than dark colorations. Considering the criteria of gingival aesthetic, different color spectra are found in the normal range that depends on various factors such as, epithelial thickness, number, and size of blood vessels, intensity, and depth of pigmentation present in epithelium. Dark gums are mainly seen in people with dark skin and it is more common in anterior labial gingiva and females (1). Pigmentation is associated with the production of melanin by melanocytes. These cells are independent of the adjacent epithelial cells and they produce melanin which plays a main role in pigmentation of the gingiva (2-4). Currently, many methods are used for this purpose including surgical stripping, free gingival graft, electro-surgery, abrasion with ceramic bur, cryo-therapy, and different types of lasers such as carbon dioxide (CO₂) (10,600 nm), diode (980 nm), neodymium-doped:

yttrium, aluminum garnet (Nd: YAG) (1064nm), erbium-doped yttrium aluminum garnet (Er: YAG) (2094 nm) (5). Among different lasers, diode lasers are often applied in dentistry. The advantages of diode laser are included affordable price, ease of operation, versatility, and small size. Diode wavelengths are heavily absorbed by hemoglobin and melanin and slightly in the hard dental tissue. This enables the diode laser for precise cutting and removing pigmented tissue with minimal damage to the adjacent tooth structure. Also, the use of a diode laser causes an inflammatory sterile reaction in which blood vessels are in surrounding tissues up to 0.5 mm in diameter. As a result, the main advantage of this laser is hemostasis and a fairly dry and non-bleeding field (6, 7). Since the patients' pain and discomfort in prolonging wound healing at the site of treatment is one of the most common post-surgical problems, the use of diode lasers is suggested while most of the mentioned conventional methods are invasive and associated with bleeding and pain (8). The light of a diode laser with a wavelength of 800 to 980 nm is poorly absorbed in water but is absorbed well in hemoglobin and melanin (9). These lasers have a thermal effect resulting in heat accumulation at the end of the initiated fiber (10).



Figure 1. Preoperative view



Figure 3. Immediate postoperative view

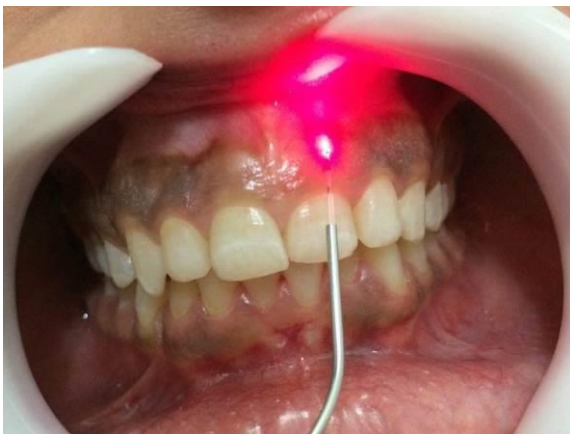


Figure 2. Intraoperative view



Figure 4: Sixth months follow-up view

This treatment for depigmentation is based on the absorption of light energy by the melanin in the melanocytes and its conversion to heat by the photothermolysis reaction, which causes the reduction in their number in the basal and suprabasal layer of the epithelium (11, 12). The current study was undertaken to evaluate the effectiveness of the 980 nm diode laser in the treatment of gingival hyperpigmentation.

Materials and Methods

The study approved by the local ethical committee, Islamic Azad University of Borujerd. First, informed consent was obtained from each patient. In this study, 24 patients (18 females and 6 males), and 18-37 years of age with pigmentation in their gum were selected to include. Inclusion criteria were as follows: having pigmentation in the jaw quadrants, no smoking, no systemic disease, and no use of drugs causing pigmentation, the absence of wound or inflammatory disease in the gum and advanced periodontal disease. Before the process, all patients were tested for blood and coagulation disorders to rule out any

contraindication for surgery. After local gingival anesthesia (2% lidocaine, 1:100000 epinephrine), the laser safety guidelines were followed to achieve complete safety (13, 14). The patient and the staff were put on special laser glasses. The 980 nm diode laser tip (Wiser, Doctor Smile, Italy) was set at an energy setting of 0.8-1 W (0.8 W used for patients with high pigmentation rate), with continuous wave (CW) and properly initiated and applied to the pigmentation site. A 300 μ m fiber was used in contact with tissue to remove epithelium considering not harming periosteum and bone. To prevent tissue overheating and carbonization that may delay tissue healing, the tip of the fiber was used with swipe motion in one direction from point A to B, to give the tissue time to decrease the temperature from laser activity (Figure 1, 2).

Patients were instructed to prevent the trauma to the operating area, and not to use hot and stiff foods to avoid irritation in the area for one week. Figures 3 and 4 demonstrate the immediate view after the operation and healed tissue after 6 months, respectively. All photogrammetric of GP was taken before the intervention, 1, 3, and 6 months after the intervention, and the results of the area and circumstance of the pigmentation were evaluated. Neither manual



Table 1. Dimensions of GP before the treatment, 1, 3 and 6 months after the intervention with 980 nm diode

Time	Mean (SD)
	980 nm laser
Primary pigmentation area	24.45 (9.80) mm ²
Primary pigmentation circumference	34.3 (6.91) mm
Primary area after 1 month	3.54 (5.27) mm ²
Primary circumference after 1 month	11.95 (15.45) mm
Primary area after 3 month	3.54 (5.27) mm ²
Primary circumference after 3 months	11.95 (15.45) mm
Primary area after 6 months	3.54 (5.27) mm ²
Primary circumference after 6 months	11.95 (15.45) mm

calculation nor formula was applied for the measurement of area & circumference; to increase accuracy and avoid human error, all measurements were performed using the measurement options of AutoCAD LT® software 2018. All operations were performed by one person (N.D), to avoid bias all images were recorded in the same location and exposure with the same camera setting. The results of this study were statistically analyzed by statistical tests of Smirnov-Kolmogorov, Friedman and Paired t-test. Also, SPSS v.22 software was used for statistical analysis.

Results

The results from comparison of the area and circumference of GP before the treatment, 1, 3 and 6 months after the intervention demonstrated that dimensions (area and circumference) of the GP was significantly reduced compared to pretreatment, the area of pigmentation at the first, third, and sixth months was constant (3.54 ± 5.27 mm²). Similarly, the circumference of pigmentation at the first, third, and sixth months was constant (11.95 ± 15.45 mm). The results are presented in Table 1. According to the data in Table 2, the GP average rate was 4 before the intervention. After the intervention, the pigmentation average rate was 2, and this rate didn't change in Follow-ups. These results indicate the lack of repigmentation and stability of treatment during this period.

Discussion

In the present study, the effect of a 980 nm diode laser on the size of the pigmentation was compared before and after the treatment of GP in the subjects. Management of gingival pigmentation has many conventional techniques, nowadays; laser is considered as an alternative and provides many benefits such as working in a bloodless and dry field, ease of application, reduced treatment duration, surgical site disinfection, no need for periodontal dressing, minimal trauma, post-operative scar and minimal pain (15-17). Different lasers are used for depigmentation. ND: YAG

Table 2. The results of Friedman's test on the comparison of the changes in the GP between the first, third, sixth months of follow-up period after treatment with 980 nm diode laser. (n=24)

Laser	Average rating	P-value
Primary pigmentation area	4.00	0.0001
Primary area after 1 month	2.00	
Primary area after 3 month	2.00	
Primary area after 6 month	2.00	

has high tissue penetration depth and less heat output in comparison to the diode laser. As a result, it is possible to damage the underlying structures of the epithelium and root surface, thus it should be used more carefully in the marginal zone of the gingiva. Therefore, the diode laser is a more conservative method for operations in soft tissue and proximity of enamel, dentin, and cementum (5, 18). CO₂ lasers are also used for soft tissue surgeries, but due to its very high absorption rate in hydroxyapatite (about 1000 times higher than erbium); the tooth adjacent to the soft-tissue surgery site should be covered. Also, the laser is used in non-contact mode causes loss of tactile sense, which can be a disadvantage for the surgeon (11). Therefore, diode laser has attracted the attention of dentists for soft tissue operations due to their small size, low cost, ease of use, minimal risk for hard tissue while it can remove a uniform layer of epithelium without damaging the connective tissue and the underlying capillary layers (19, 20). Although the diode laser is safe for soft tissue surgeries, periosteal exposure is possible in patients with thin gum biotype. Also, diode laser, like other lasers, has more healing time than the conventional method. This laser can also cause soft tissue damage in CW mode due to excessive heat generation, so it may be necessary to use air or water to cool the surgical area or use swipe motion to give the tissue time to decrease the temperature that we used in this study (11, 14, 21). Based on the theory of migration, active melanocytes migrate from the pigmented tissues adjacent to the treated areas and cause some degree of treatment failure. A study has been conducted by Chhina *et al.*, to examine the recurrence of gingival pigmentation after the surgical operation. Analysis of the patient's response for pain with laser and surgical stripping revealed that the pain level in the diode laser group was less than the surgical stripping and no difference in recurrence of pigmentation (22). Guler *et al.*, compared gingivectomy techniques with ceramic burs, diode laser, and scalpel. they concluded that the laser group had less postoperative pain and complications of wound healing than the other two groups in 1 and 3 days (23). In the study of Timucin *et al.*, bacterial count in the laser group was significantly lower than the conventional group on the day after surgery but this trend was not significant in further follow-ups. There was no significant difference between the two groups regarding pain after the operation, and the rate of wound healing was better in all follow-



ups after surgery in the conventional group (24). Gul et al., in a review study of the most effective method for the management of GP concluded that laser, especially diode laser, is a new alternative method with maximum aesthetic results, less pain, shorter healing period, and patient preference and post-operative satisfaction. Whereas, the laser group showed a higher repigmentation rate in the first six months after surgery (25).

Conclusion

The 980nm diode laser was very useful for the management of GP in this study. Diode laser technique is a safe, effective, with minimal pain, and with excellent aesthetic results that provide maximum comfort to both patient and dentist. To achieve conclusive results it is recommended more study with large samples and with more follow up periods to evaluate the repigmentation rate.

Conflict of Interest: 'None declared'.

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