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Diode Laser-Assisted Gingival Melanin Depigmentation: Clinical Case Series

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Abstract **Case Report**

Gingival melanin hyperpigmentation, though physiologic, often represents an esthetic concern, especially among patients with high smile lines. This case series evaluates the clinical effectiveness of the Wiser2 diode laser (980 nm) for gingival depigmentation. Multiple patients presenting with diffuse anterior gingival pigmentation were treated under topical anesthesia using 2% Xylocaine gel, with a power setting of 1.5 W in continuous mode. The procedure was minimally invasive, bloodless, and well tolerated. Rapid healing was observed within one week, and a uniform coral-pink gingival color was achieved within two to three weeks. Follow-up at one, three, and six months demonstrated stable esthetic results, absence of repigmentation, and high patient satisfaction. The diode laser's strong absorption by melanin and hemoglobin provided precise epithelial ablation, effective hemostasis, and minimal postoperative discomfort. Within the limitations of this case series, the 980 nm diode laser proved to be a safe, predictable, and efficient method for the esthetic management of gingival hyperpigmentation.

Keywords: Gingival depigmentation, Diode laser, Melanin hyperpigmentation, Esthetics, Periodontics, Minimally invasive surgery.

INTRODUCTION

Periodontal health plays a pivotal role not only in maintaining oral function but also in achieving optimal smile esthetics. Increasing attention has been directed toward the gingival appearance, as the color, contour, and harmony of the gingiva strongly influence the perception of dental esthetics [1].

Gingival hyperpigmentation, particularly of melanin origin, is a benign condition characterized by excessive melanin deposition in the basal and suprabasal layers of the gingival epithelium. Clinically, it manifests as brown to black discolorations, commonly referred to as "black gums." Although medically harmless, these pigmentations often constitute a significant esthetic concern, especially in patients with a high smile line or demanding esthetic expectations [2].

Over the years, various techniques have been proposed for the removal of gingival pigmentation, including surgical stripping, bur abrasion, cryotherapy, electrosurgery, and chemical cauterization [3]. While effective, these conventional approaches are associated with limitations such as intraoperative bleeding, postoperative discomfort, delayed wound healing, or an increased risk of recurrence.

Lasers have been successfully applied in several dental specialties thanks to their precision, hemostatic properties, reduced postoperative discomfort, and enhanced wound healing [4]. Specifically, diode lasers have demonstrated high effectiveness in gingival depigmentation procedures. They offer a minimally invasive, predictable, and esthetically superior alternative to conventional techniques, ensuring bloodless surgery, improved patient comfort, and favorable healing outcomes with reduced recurrence rates [5,6]. This case series aims to present the clinical outcomes of gingival depigmentation performed with a diode laser, underlining its efficacy, safety, and patient satisfaction in the esthetic management of melanin gingival hyperpigmentation.

Operative Protocol

The procedure was carried out under topical anesthesia (lidocaine 10%), ensuring adequate patient comfort. A diode laser (980 nm, Wiser II, Doctor Smile, Italy) was used in continuous mode with a power output of 1.5 W and a 400 µm fiber optic tip. The laser was

applied using light brushing strokes in a non-contact, sweeping motion, maintaining a distance of approximately 1 mm from the gingival surface.

The pigmented epithelial layer was carefully ablated until the underlying connective tissue appeared light pink, avoiding excessive thermal damage or exposure of underlying bone. Continuous movement of the fiber and intermittent pauses minimized the risk of overheating. The entire depigmentation procedure was completed in a single session lasting approximately 30 minutes.

To prevent overheating, the tip was kept in constant motion, and the surgical field was intermittently cooled with saline-soaked gauze.

No periodontal dressing was required postoperatively. Postoperative instructions included refraining from smoking, avoiding hot and spicy foods, and maintaining meticulous oral hygiene, and use a chlorhexidine 0.12% mouth rinse twice daily for 10 days.

Case Presentation

A 25-year-old male patient presented to the Department of Periodontology with a chief complaint of dark-colored gums that he perceived as unaesthetic, particularly when smiling (Figures 1). The patient reported being a regular smoker but had no significant systemic or medical history.

On extraoral examination, the patient displayed a medium smile line, with full exposure of the anterior gingiva. Intraoral clinical examination revealed diffuse brownish-black pigmentation affecting both the maxillary and mandibular anterior gingiva, extending from canine to canine. The pigmentation was symmetrical and most pronounced along the marginal and attached gingiva.

The severity of pigmentation was assessed using the Dummett–Gupta Oral Pigmentation Index (DOPI) [7], and a score of 3 was assigned, indicating heavy pigmentation. The distribution pattern was classified according to the Hedin Melanin Index (HMI) as diffuse and continuous [8]. The gingival tissues were otherwise clinically healthy, with no signs of inflammation or attachment loss. Given the patient's esthetic concerns and the clinical findings, gingival depigmentation using a diode laser was planned as the treatment of choice.

Table 1: Dummett-Gupta Oral Pigmentation Index (DOPI) Table 2. Hedin's Classification

Dummett–Gupta Oral Pigmentation Index (DOPI)	
Score 0	No clinical pigmentation (pink tissue).
Score 1	Mild clinical pigmentation (mild light brown color).
Score 2	Moderate clinical pigmentation (medium brown or mixed pink and brown coloration).
Score 3	Heavy clinical pigmentation (deep brown or bleu-black tissue).
Hedin Melanin Index (HMI)	
Degree 0	No pigmentation.
Degree 1	Isolated-only 1 or 2 pigmented interdental papillae.
Degree 2	Numerous (more than 2) pigmented interdental papillae.
Degree 3	Short continuous ribbons.
Degree 4	Long continuous ribbon covering the intercanine area.

Figure 1: Preoperative intraoral view showing diffuse melanin pigmentation of the maxillary and mandibular anterior gingiva

Figure 2: Intraoperative view during diode laser application (Wiser2, 980 nm) using contact mode with a 400 µm fiber

Figure 3,4,5: Immediate postoperative clinical aspect showing erythematous gingiva free of pigmentation

Healing was uneventful: during the first week, a thin fibrin layer was observed; by the second, complete epithelialization was noted with a uniform, healthy pink gingival appearance and no clinical evidence of delayed healing or infection (Figure 6,7,8).

Figure 6,7,8: One-week postoperative follow-up demonstrating fibrin layer formation and initial healing.

By the 1-month follow-up, complete healing was achieved, and the gingiva exhibited a uniform pink color with significant improvement in esthetics. The patient expressed high satisfaction with the esthetic outcome, particularly when smiling (Figure 9).

Figure 9: One-month follow-up with complete epithelialization and uniform pink gingival color.

Figure 10: 6-months follow-up with complete epithelialization and uniform pink gingival color

Case presentation

The third case concerns a 31-year-old male patient, smoker, and in good general health. The patient sought treatment for dark discoloration of the anterior gingiva, which caused aesthetic discomfort, especially during smiling.

Intraoral examination revealed a physiologically healthy periodontium, with generalized melanin pigmentation affecting both maxillary and mandibular anterior regions. The pigmentation appeared diffuse, bilateral, and well- demarcated, with no clinical signs of inflammation, attachment loss, or mucosal pathology.

According to the Dummett Oral Pigmentation Index (DOPI), the intensity of pigmentation was scored 3, corresponding to a deep brown to black coloration. The Hedin Melanin Index (HMI) was degree 4. No local irritants, amalgam tattoos, or pathological lesions were observed.

Figure 1: Preoperative intraoral view showing diffuse melanin pigmentation of the maxillary and mandibular anterior gingiva

Figure 2,3,4: Immediate postoperative clinical aspect showing erythematous gingiva free of pigmentation

Figure 5,6,7: One-week postoperative follow-up demonstrating fibrin layer formation and initial healing

Figure 8,9,10: 6-months follow-up with complete epithelialization and uniform pink gingival color

DISCUSSION

Gingival hyperpigmentation, although medically benign, often constitutes a significant esthetic concern, particularly in patients with high smile lines. Over the years, several treatment modalities have been proposed for gingival depigmentation, including scalpel surgery, bur abrasion, cryotherapy, electrosurgery, and chemical agents. While effective, these conventional methods are frequently associated with limitations such as bleeding, postoperative pain, longer healing periods, and higher risk of repigmentation [1,2,9].

Other treatment modalities include laser depigmentation, which offers several advantages such as a reduced risk of infection and enhanced wound healing [10]. The accelerated healing process is attributed to the laser's ability to stimulate collagen synthesis and epithelialization [11]. Moreover, its bactericidal effect provides a sterile environment, thereby minimizing the risk of infection [12].

Diode lasers, with a wavelength range of approximately 800 to 1000 nm, are widely used in modern dentistry. Within this spectrum, melanin exhibits the highest absorption while hydroxyapatite shows the lowest [13]. Owing to their high affinity for melanin, diode lasers are particularly suitable for gingival depigmentation, ensuring minimal risk to dental hard tissues. [14,15]

The biological rationale for diode laser efficacy lies in its wavelength-specific absorption and photothermal effect. The 980 nm wavelength emitted by the Wiser2 diode laser is selectively absorbed by melanin and hemoglobin, allowing targeted ablation of the pigmented epithelium with simultaneous hemostasis. Moreover, the thermal effect may reduce melanocyte activity and delay migration from adjacent tissues, contributing to low recurrence rates [16].

The clinical outcomes obtained in this case indicate that the use of a 980 nm diode laser (Wiser2, Lambda S.p.A., Italy) at a power setting of 1.5 W in continuous mode provided excellent intra-operative control and postoperative comfort. The laser's ability to achieve microvascular coagulation and partial neural desensitization explains the minimal bleeding and reduced discomfort observed during and after treatment compared with conventional surgical techniques. The photothermal interaction between the laser beam and the pigmented tissue ensures rapid hemostasis, precise ablation, and accelerated healing while minimizing collateral damage to adjacent gingiva.

During irradiation, melanin chromophores absorb the laser photons, producing a localized temperature increase sufficient to induce protein denaturation and coagulation within the pigmented epithelial layer [17]. This controlled thermal reaction enables efficient pigment removal while preserving the underlying connective tissue. In the present case, topical anesthesia with 2% Xylocaine gel was applied to the treated area to enhance patient comfort, as the procedure was well tolerated and did not require infiltration anesthesia [18].

Several types of lasers have been investigated for gingival depigmentation, including carbon dioxide (CO_2, 10,600 nm), erbium-doped yttrium-aluminum-garnet (Er:YAG, 2940 nm), and neodymium-doped yttrium-aluminum-garnet (Nd:YAG, 1064 nm) lasers. Each system has distinct tissue interactions based on its wavelength and absorption characteristics.The CO_2 laser, with strong absorption in water, allows superficial ablation and effective hemostasis but may cause carbonization and delayed healing due to excessive thermal effects [19]. The Er:YAG laser, absorbed mainly by water and hydroxyapatite, produces minimal thermal damage and promotes rapid healing but offers limited hemostatic control, making it less ideal for highly vascularized tissues [20]. The Nd:YAG laser penetrates deeper and is highly absorbed by melanin and hemoglobin, but its deeper thermal effect increases the risk of underlying tissue damage [21]. In contrast, the diode laser (810–980 nm) combines high melanin affinity with moderate penetration depth, providing excellent hemostasis, precise epithelial ablation, and reduced postoperative morbidity. Consequently, diode lasers are often considered the most practical and cost-effective option for routine clinical use in depigmentation [22].

Repigmentation remains a potential concern following any depigmentation procedure. It may result from the migration of active melanocytes from adjacent untreated areas, the reactivation of residual melanocytes within the basal layer, or patient-related factors such as genetic predisposition and smoking [23]. Clinical studies have reported variable recurrence rates depending on the technique and duration of follow-up. Dummett and Barens first described spontaneous repigmentation occurring within 24 months after surgical procedures [24]. However, diode lasers have been associated with a lower risk and delayed onset of repigmentation compared with conventional techniques [25]. The photothermal effect may temporarily inactivate melanocytes and reduce their migration, contributing to long-term stability of esthetic results. In the present case, no recurrence was observed after six months, confirming the diode laser's ability to achieve a predictable and durable outcome.

CONCLUSION

Diode laser-assisted depigmentation represents a safe, minimally invasive, and effective approach for the management of melanin-induced gingival hyperpigmentation. In this case, the Wiser2 diode laser (980 nm) provided excellent hemostasis, minimal postoperative discomfort, and rapid healing, with stable esthetic results maintained over 6 months. Compared

with conventional techniques, diode laser therapy offers superior patient comfort and predictable clinical outcomes. Long-term studies with larger sample sizes are, however, necessary to further validate its effectiveness and evaluate the risk of repigmentation.

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