



A contemporary approach to management of gingival hyperpigmentation: a case series

Vedavalli Subramanian¹ · S. K. Balaji¹ · Vamsi Lavu¹

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Abstract

Purpose Excessive pigmentation of the gingiva has a varied etiology and is often considered unesthetic. Depigmentation is a sought-after treatment and can be achieved by different techniques such as surgical blade, electrosurgery, and contemporary approaches such as the lasers. This case series aims to provide a clinical perspective on the use and efficacy of 940 nm diode laser for management of gingival hyperpigmentation.

Methods Three patients with excessive gingival pigmentation as identified by using the Dummett-Gupta Oral Pigmentation Index were treated with diode laser (940 nm wavelength) with 2 W power in a continuous wave mode and 300/400-micron fiber. The laser was used in light contact with the gingiva with overlapping brush strokes being used to depigment the area by de-epithelialization of the site. The Dummett-Gupta Oral Pigmentation Index [DOPI] was assessed at baseline and three-month follow-up to assess and quantify the change in pigmentation achieved.

Results The Dummett-Gupta Oral Pigmentation Index scores showed a change from 3 at baseline to 1 at 3 months post-surgery in most sites assessed (64.3%). In some sites, the post-operative scores at 3 months follow-up were 0 (35.7%).

Conclusion The selective absorption of 940 nm diode laser into melanin allows for efficient depigmentation with low power settings and with minimal collateral tissue damage. Hence, 940 nm diode laser would be an optimum tool for clinical management of depigmentation.

Keywords Depigmentation · Gingival pigmentation · Laser · Melanin

Introduction

Gingival hyperpigmentation is defined as a darker gingival color beyond what is normally expected [1]. The etiology of gingival hyperpigmentation can be either physiologic or pathologic. The physiologic cause could be due to the excessive deposition of melanin in the suprabasal and basal cell layers of the epithelium, contributed by products like melanin, melanoid, iron, reduced hemoglobin, oxyhemoglobin, bilirubin, and carotene. The pathologic causes could be idiopathic or due to endocrine diseases such as acromegaly,

Addison's disease, use of drugs such as quinine, chloroquine, and heavy metals such lead, bismuth, mercury, and silver. Mucosal conditions such as lichen planus, blue nevus, hemangiomas, and tobacco consumption are other conditions causing gingival hyperpigmentation [2]. Gingival pigmentation is evaluated with the help of Dummett-Gupta Oral Pigmentation Index [DOPI] [3], where a score of 0 means no clinical pigmentation (pink gingiva), 1, mild clinical pigmentation (mild light brown color); 2, moderate clinical pigmentation (medium brown or mixed pink and brown); and 3, heavy clinical pigmentation (deep brown or bluish black). Excessive gingival pigmentation not just has an impact on the esthetics, but also creates a psychological impact on the patients. This impact is aggravated in patients with excessive gingival display and high smile line [4]. Gingival depigmentation is a treatment of choice where esthetics is a concern and is accepted by most patients. The conventional methods of depigmentation include gingival abrasion, scalpel surgical technique, the use of free gingival grafts, and gingival veneers. The various contemporary approaches include

✉ Vamsi Lavu
lavu.vamsi@gmail.com

Vedavalli Subramanian
vedavs96@gmail.com

S. K. Balaji
drskbalaji@rediffmail.com

¹ Department of Periodontics, Sri Ramachandra Institute of Higher Education and Research, Chennai, India

electrosurgery, cryosurgery, and lasers. Among which lasers is the most desired and accepted method of gingival depigmentation. The different lasers used for depigmentation are diode lasers, CO₂ laser, and Erbium family of lasers. The present case series includes patients treated for physiologic gingival hyperpigmentation using the diode laser based on the psychological esthetic need of the patients.

Case series

Three patients aged between 14 and 30 years, two females, and one male with a wheatish complexion had visited the Department of Periodontology with a chief complaint of blackish gums for the past several years. Patients had no pre-existing medical condition and were not under any medication for a long duration. The patients also did not have any relevant dental history. On oral examination, gingival hyperpigmentation was evident in relation to all four quadrants of the oral cavity [Fig. 1a, b, and c]. The DOPI index assessment was done for all the patients [Table 1]. The patients were explained about the various treatment options for gingival depigmentation including scalpel, electrosurgery, laser, and gingival veneer. The patients then opted for laser, as they considered it to be safe and minimally invasive and had high esthetic expectations. A written informed consent was obtained from all the individual participants. They

were detailed about the entire procedure, and after a thorough oral prophylaxis and following routine blood investigations (bleeding time, clotting time, prothrombin time, partial thromboplastin time, and international normalized ratio), the patients were taken up for gingival depigmentation using diode laser (940 nm wavelength, continuous wave mode). The laser operative parameters are summarized in [Table 2]. The patient, operator, and the assistant were given protective eyewear prior to the procedure. Under topical local anesthesia, LA [lignocaine 1:2,00,000 concentration], gingival depigmentation was performed using a diode laser in the contact mode with a light sweeping motion in the area between the gingival margin and mucogingival junction for both the upper and lower arches [Fig. 1d, e, and f]. The depigmentation was performed from molar to molar in both the arches, and the anesthetic spray was used as and when required. The area depigmented was gently wiped with a moist gauze after every stroke, and the charred tissue at the tip of the laser was cleaned with the help of a gauze soaked in saline. The immediate post-operative images were taken [Fig. 1g, h, and i]. The patients had no pain, discomfort, or bleeding during and after the procedure.

The post-operative instructions were given to the patients; they were asked not to consume hot and spicy foods for the next 3 days post the procedure. Patients were advised a medication of Tab Aceclofenac 100 mg + Paracetamol 325 mg twice daily, after food for 3 days and

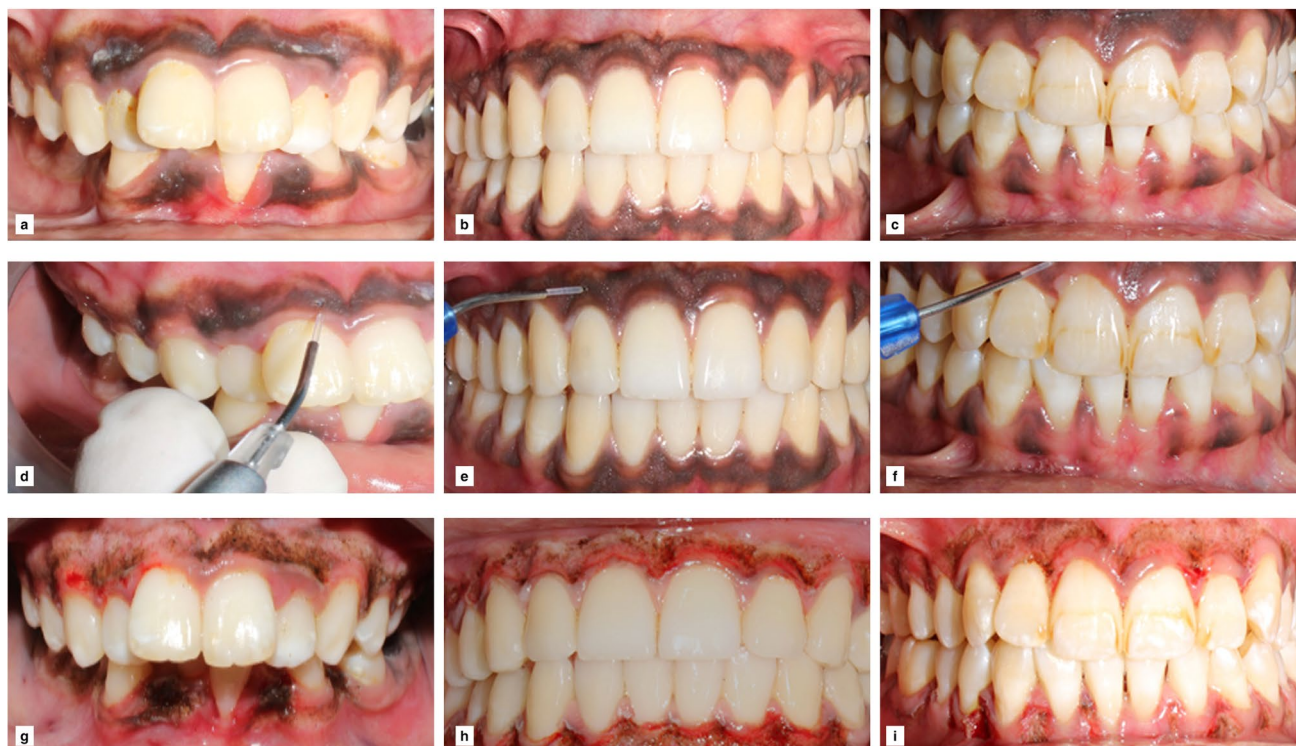


Fig. 1 a–c Pre-operative images, d–f intra operative images, and g–i immediate post-surgery images of the sites treated for depigmentation.

Table 1 Dummett-Gupta Oral Pigmentation Index assessed at baseline and 3-month follow-up of all the patients

Patient 1: Baseline	17	16	15	14	13	12	11	21	22	23	24	25	26	27
	2	2	2	2	3	3	3	3	3	3	2	2	2	2
	2	2	2	2	2	3	3	3	3	3	2	2	2	2
	47	46	45	44	43	42	41	31	32	33	34	35	36	37
Patient 1: Post-operative (after 3 months)	17	16	15	14	13	12	11	21	22	23	24	25	26	27
	1	1	1	1	0	0	0	1	1	1	1	1	1	1
	1	1	1	0	1	0	0	0	0	1	1	1	1	1
	47	46	45	44	43	42	41	31	32	33	34	35	36	37
Patient 2: Baseline	17	16	15	14	13	12	11	21	22	23	24	25	26	27
	2	2	3	3	3	3	3	3	3	3	3	3	2	2
	2	2	3	3	3	3	3	3	3	3	3	3	2	2
	47	46	45	44	43	42	41	31	32	33	34	35	36	37
Patient 2: Post-operative (after 3 months)	17	16	15	14	13	12	11	21	22	23	24	25	26	27
	0	0	1	1	1	1	1	1	1	1	1	1	1	1
	0	0	0	0	0	1	0	1	1	0	1	1	1	0
	47	46	45	44	43	42	41	31	32	33	34	35	36	37
Patient 3: Baseline	17	16	15	14	13	12	11	21	22	23	24	25	26	27
	3	3	3	3	3	2	3	3	3	3	3	3	3	3
	3	3	3	3	3	3	1	1	3	3	3	3	2	2
	47	46	45	44	43	42	41	31	32	33	34	35	36	37
Patient 3: Post-operative (after 3 months)	17	16	15	14	13	12	11	21	22	23	24	25	26	27
	1	1	1	0	0	0	0	1	0	0	1	1	1	1
	1	1	1	0	0	0	0	0	0	1	1	1	1	1
	47	46	45	44	43	42	41	31	32	33	34	35	36	37

The boldface represents teeth numbering as per FDI World Dental Federation notation

Table 2 Laser wavelength and operating parameters used

Laser wavelength	940 nm
Continuous wave/pulsed mode	Continuous wave mode
Power	2 W
Contact/non-contact mode	Contact mode
Fiber-optic tip diameter	300/400 μ m
Duration	For full mouth 20 min (1200 s) with intermittent application
Energy	$2 \times 1200 \text{ s} = 1400 \text{ J}$

were instructed to use 0.2% of chlorhexidine mouth rinse, diluted 1:1 with water twice daily from the next day of the procedure for 10 days in order to maintain proper oral hygiene. The patients were reviewed after 3 months, the healing was satisfactory with no scar formation observed in any of the patients [Fig. 1g, h, and i], and the DOPI was assessed again in the three patients which revealed a change in scores from 3 to 0 in 35.7% of the sites assessed and from score 3 to score 1 in 64.3%. The patients were highly satisfied with the esthetic outcome and reported with no pain and discomfort 3 months post-operatively [Fig. 2a–f].

Discussion

Gingival depigmentation is defined as a periodontal plastic surgical procedure whereby the gingival hyperpigmentation is removed or reduced by various techniques [4]. Among the different methods for gingival depigmentation, lasers are beneficial as it doesn't involve the use of blades and suturing and resolves the fear of needles in patients. Lasers provide a unique solution since the absorption spectrum of laser wavelength is specific to certain chromophores in the tissue on which it is incident. The gingiva has melanin distributed in the epithelium and upper layers of the connective tissue, hemoglobin present in the blood vessels of the gingiva, and water an essential component of the ground substance. Hence, three key chromophores are available in sufficiently large quantities which allows for selective absorption of the laser wavelengths. The depigmentation procedure was performed by using a semiconductor diode laser with $940 \pm 15 \text{ nm}$ wavelength. This laser wavelength has differential absorption in the chromophores in gingiva [5]. It is more absorbed in the melanin and hemoglobin with poor absorption in water (transmission through water). This selective absorption in melanin makes this wavelength suitable for depigmentation as compared to the lasers absorbed

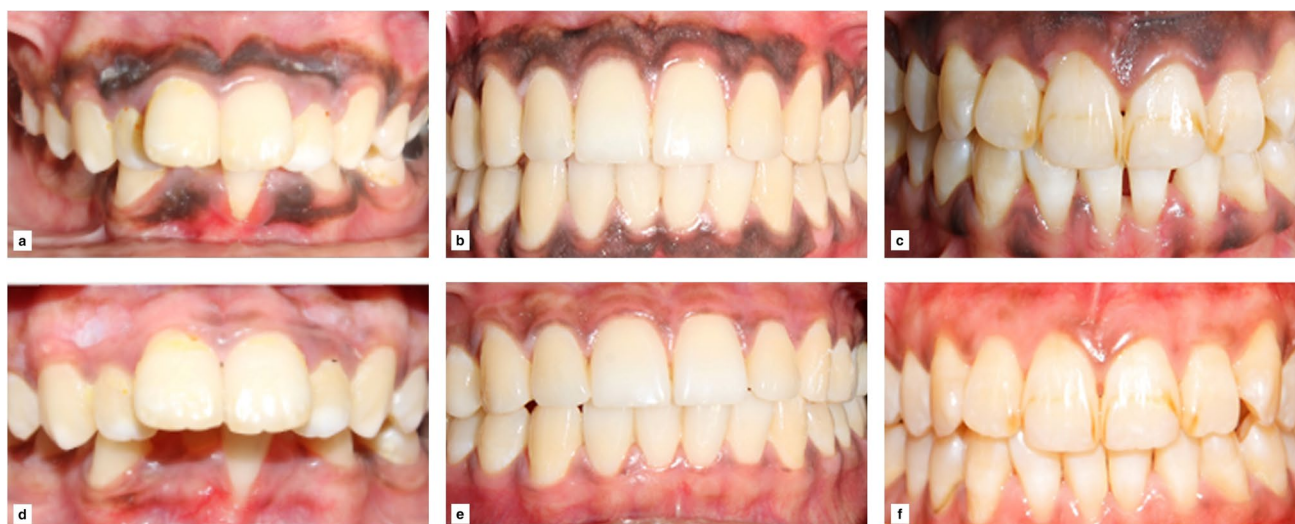


Fig. 2 Comparison of **a–c** pre-operative images and **d–f** 3 months post-operative images of the patients

in water such as Erbium family of lasers. Another significant advantage of this “selective absorption” is that clinically a faster procedure can be done with minimal damage to the surrounding tissues and using a lower power setting. The high amount of chromophore in the gingiva of a patient with hyperpigmentation allows for use of low power settings (2 W) in a continuous wave mode with intermittent sweeping strokes as used in this study. The use of low power also enables a photobiomodulatory activity of the laser as the beam gets attenuated as it passes into the deeper layers due to both absorption and scattering in the gingiva.

The most common problem associated with gingival depigmentation is recurrence. In order to minimize the chances of recurrence, there has been a change in concept of depigmentation wherein previously the procedure was performed in the esthetic areas, but currently it is done from molar to molar in each arch. This is based on the migration theory, which states that the active melanocytes from the adjacent pigmented tissues migrate to treated areas, causing repigmentation [6]. However, the rate of repigmentation is reduced in lasers compared to the other techniques of depigmentation. A systematic review by Yi Hung Lin et al. [7] concluded that cryosurgery, electrosurgery, and lasers are promising for gingival depigmentation with less recurrence of pigmentation. Among the lasers which can be used, the diode laser seems to be the optimal choice, with the highest clinical efficacy [7]. According to the observations of a randomized controlled trial by Altayeb W, Hamadah [8] which compared the efficacy of diode laser and Er Cr YSGG laser, the results revealed better long-term stability of gingival color, with a lower incidence of re-pigmentation using diode lasers. The results of the randomized controlled trial by Harpreet Singh et al. in 2014 [9] comparing the scalpel and diode laser in gingival depigmentation demonstrated

both treatment modalities to be equally effective, although the recurrence rate was low in patients who underwent laser de pigmentation, proving it to be more efficacious.

When comparing lasers with other techniques, it is safe, minimally invasive, convenient, and time-saving with no severe pain observed during the procedure and post-operatively. The proved antimicrobial effects of laser could be the reason behind the reduced infection, swelling, and less bleeding; these findings in our patients are in accordance with the studies by Kishore et al. [10] and Giannelli et al. [11]. One of the limitations of using the diode laser is that the depigmentation appears incomplete in the immediate post-operative period due to the small diameter of the tip [400 μm only] which when used in areas with high pigmentation doesn't allow for complete physical removal of the tissue. However due to “selective ablation” and photo thermal activity with some lateral heat transfer, the post-operative healing always demonstrates a complete removal of the pigment in following healing of the surgical site.

To conclude, gingival biotype, clinician's expertise, patient preferences, and recurrence rate greatly determine the selection of a technique for gingival depigmentation. Although a wide range of techniques have been employed, lasers have been reported to be superior with better esthetic results and low rate of recurrence. Therefore, laser gingival depigmentation should be considered as part of the esthetic management along with the teeth, as an integrated approach for better results with respect to patient's esthetic concerns.

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Author contribution 1. Dr. Vedavalli Subramanian performed patients' recruitment and carried out the depigmentation procedure and manuscript writing.

2. Dr. S.K Balaji had administrative oversight and contributed to manuscript editing.

3. Dr. Vamsi Lavu was involved in concept design, patient follow-up, manuscript writing, and editing.

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Declarations

Ethics approval Not applicable as it is a case series.

Consent for publication The authors affirm that the participants provided informed consent for publication of the images in Figs. 1 and 2.

Competing interest The authors declare no competing interests.

References

- Ozbayrak S, Dumlu A, Ercalik-Yalcinkaya S (2000) Treatment of melanin pigmented gingiva and oral mucosa by CO₂ laser. *Oral Surg Oral Med Oral Pathol Oral Radiol Endod* 90:14–15
- Alasmari DS (2018) An insight into gingival depigmentation techniques: the pros and cons. *Int J Health Sci (Qassim)* 12(5):84–89
- Dummett CO, Barends G (1971) Oromucosal pigmentation: an updated literary review. *J Periodontol* 42:726–736
- Malhotra S, Sharma N, Basavaraj P (2014) Gingival esthetics by depigmentation. *J Periodontal Med Clin Pract* 1:79–84
- Azma E, Safavi N (2013) Diode laser application in soft tissue oral surgery. *J Lasers Med Sci* 4(4):206–211
- Raghu Raaman A, Pratebha B, Jananni M, Saravanakumar R (2016) Comparison of efficacy of depigmentation of gingiva in terms of ImageJ intensity values and surface area of repigmentation using scalpel and diode laser. *Int J Oral Health Sci* 6:2
- Lin YH, Tu YK, Lu CT, Chung et al (2014) Systematic review of treatment modalities for gingival depigmentation: a random-effects poisson regression analysis. *J Esthet Restor Dent* 26(3):162–178
- Altayeb W, Hamadah O, Alhaffar BA, Abdullah A, Romanos G (2021) Gingival depigmentation with diode and Er, Cr:YSGG laser: evaluating re-pigmentation rate and patient perceptions. *Clin Oral Investig* 25(9):5351–5361
- Grover HS, Dadlani H, Bhardwaj A, Yadav A, Lal S (2014) Evaluation of patient response and recurrence of pigmentation following gingival depigmentation using laser and scalpel technique: a clinical study. *J Indian Soc Periodontol* 18(5):586–592
- KishoreA KathariyaR, DeshmukhV VS, KhaliaN DandgavalR et al (2014) Effectiveness of Er: YAG and CO₂ lasers in the management of gingival melanin hyperpigmentation. *Oral Health Dent Manag* 13:486–491
- Giannelli M, Formigli L, Bani D (2014) Comparative evaluation of photoablative efficacy of erbium: Yttrium-aluminium-garnet and diode laser for the treatment of gingival hyperpigmentation. A randomized split-mouth clinical trial. *J Periodontol* 85:554–561

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