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ORIGINAL ARTICLE

Semiconductor Diode Laser provides Desirable Smile: A Clinical and Histological Study with 1-year Follow-up

Abhishek Gautam

ABSTRACT

Aim: The semiconductor diode (SCD) laser is compact, cost-effective, and versatile tool for performing soft tissues applications. The advantage of laser includes a relatively bloodless operating field, sterilization of the wound site, minimal swelling and scaring, reduction of surgical time, and less postoperative pain to the patients in dentistry. This technique is successfully used to evaluate the effects for removal of gingival melanin hyperpigmentation and to assess the color of gingiva pain, wound healing along with the appearance of gingival repigmentation by clinical and histological examination in the present study.

Materials and methods: For this purpose, 5 patients were studied, which includes four females and one male, age between 19 and 40 in which four patients were nonsmokers and one was smoker found periodontally healthy and had no systemic diseases.

Results: The SCD laser found effective in removing gingival melanin pigmentation as well as no bleeding with any significant pain was reported by patients. However, repigmentations were observed with Fontana-Masson staining.

Conclusion: These results pointed out that SCD is good and safe for removal of pigmented gingiva without local anesthesia. The postoperative period is comfortable for the patient and healing is fast and good.

Clinical significance: The SCD laser is easy and effectively used for gingiva hyperpigmentation removal. Ablation of gingival hyperpigmented areas was accomplished without any bleeding complication or slight pain or no pain observed, which provide clean field during time of procedures, uneventful healing without any complication. No recurrence or slight recurrence of pigmentation had been found in 12 months follow-up.

Keywords: Depigmentation, Hyperpigmentation, Repigmentation, Semiconductor diode.

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Practitioner

Department of Periodontology, Chandra Dental College and Hospital, Barabanki, Uttar Pradesh, India

Corresponding Author: Abhishek Gautam, Practitioner Department of Periodontology, Chandra Dental College and Hospital, Barabanki, Uttar Pradesh, India, Phone: +919506305424 e-mail: dr.abhi90@gmail.com

INTRODUCTION

Specific targeting of melanosomes may allow for laser therapy of pigmented cutaneous lesion in dermatology and plastic surgery.[1-3] In dentistry, melanin pigmentation of the gingiva is considered to be esthetic disorder rather than disease.[4] Treatment of such cases usually involves traditional, chemical, and cryosurgery.[4-6] Surgery with gingivectomy normally reduced requiring local anesthesia, incision, and postoperative management with periodontal dressing.[7] On the other hand, chemical surgery with phenol may have a toxic side effect.[8] Therefore, many people are hoping for a simple alternative technique instead of these surgical techniques in the treatment of this disorder.

Nd:YAG and argon lasers are reported to be useful in removing gingival pigmentation due to their deep tissue penetrability and selective destruction of pigmented cells found in the basal cell layer under epithelium.[9,10] Color dependency and tissue penetration are thought to be necessary for treatment of melanin pigmentation. However, it has been reported that the depth of thermal damage to argon and Nd:YAG lasers extends up to 200 and 600 µm respectively.[11] Therefore, such penetrability may damage the underlying alveolar bone covered by thinner oral mucosa.

The low power is considered beneficial for the treatments of hypersensitive dentin, herpes labialis, and oral ulceration.[7,10] Its effect is reported to be not due to a heating process, but to radiation.[12-14] Recently, a middle-power semiconductor laser by which soft tissue can be cut has been developed and is already being used in dentistry as well as in medicine. Semiconductor diode (SCD) laser is another popular and available device in the clinical field. It has been used for removal of gingival hyperpigmentation.

MATERIALS AND METHODS

A total of five patients (with four females and one male, 19–40 years old) participated in this clinical study. Four patients were nonsmokers and one was smoker. They presented with the gingival melanin hyperpigmentation at the anterior part of the upper and/or lower gingiva (Fig. 1). All patients were periodontally healthy and had no systemic diseases. Informed consent had been obtained from each patient, prior to treatment.

Fig. 1: Semiconductor diode laser used in study

Fig. 2: Preoperative picture of patient

Laser Device

The SCD lasers (Fig. 1) used in this study with continuous wavelength 810 nm were applied at 3 W of power via pencil-sized handpiece containing a 300 µm lasing fiber. The procedure was performed in a contact mode. The remnants of the charred ablated tissue were removed using a sterile dampened gauze soaked in saline. Periodontal dressing was placed on the operated site. Analgesics were prescribed. No antibiotics were given. Patients were asked to avoid trauma to the treated gingiva and refrain from acidic and hot food. For 1 week Chlorhexidine mouthwash (0.12%) for 2 weeks was prescribed. Safety glasses of specific wavelength as provided by the manufacturer were worn by the operator, patient, and assistant. Highly reflective instruments or instruments with mirrored surfaces were avoided, as there could have been reflection of the laser beam. Also care was taken to avoid laser in the presence of explosives and inflammable material.

Clinical Evaluation

Clinical parameters, such as wound healing, pain, were evaluated immediately after and then at 1 week, 1, and 3 months of surgery. Color of pigmentation was evaluated after 1, 3, 6, and 12 months postoperatively. Histological examination was performed preoperatively and 12 months postoperatively.

Preoperative (Fig. 2) and postoperative (Fig. 3) observations about the gingival melanin pigmentation were made according to Dummett-Gupta Oral Pigmentation Index scoring criteria given by Dummett.[15]

- No clinical pigmentation (pink gingiva)
- Mild clinical pigmentation (mild light brown color)
- Moderate clinical pigmentation (medium brown or mixed pink and brown color)
- Heavy clinical pigmentation (deep brown or bluish black color)

Fig. 3: Postoperative picture of patient

Wound healing was observed:

- Complete epithelization
- Incomplete epithelization/partial epithelization
- Ulcer
- Tissue defect.

Pain was evaluated using visual analog scale score. If the score was 0 – no pain, scores between 0.1 and 3.0 were recorded as slight pain, 3.1 to 6.0 was considered as moderate pain, and scores of 6.1 to 10 were recorded as severe pain.[16] Histological examination was performed before (Fig. 4) and 1 year after treatment (Fig. 5). Biopsies were taken from unlashed and lashed areas of the gingiva. Sample were then fixed with buffered formalin solution and embedded in paraffin. Histological sections were examined using Masson-Fontana staining.

RESULTS

During the procedure, laser ablated the gingival epithelial surface little by little to reach the pigment without causing any bleeding, which was beneficial for clear visualization. Removing deeper pigment resided below

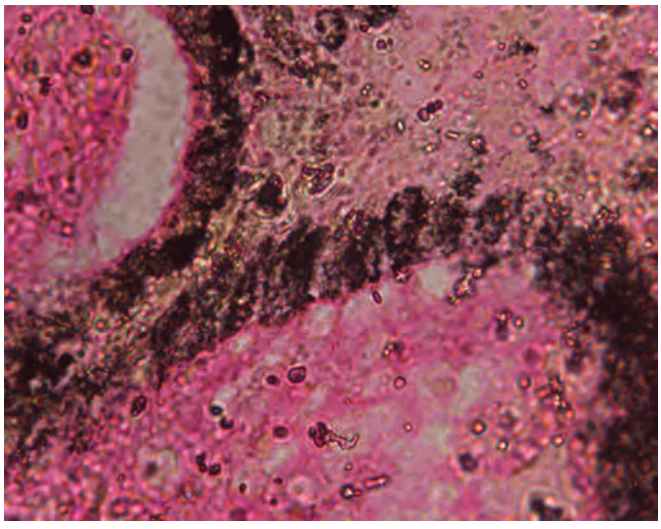

Fig. 4: Preoperative picture after Fontana-Masson staining taken at 100× resolution

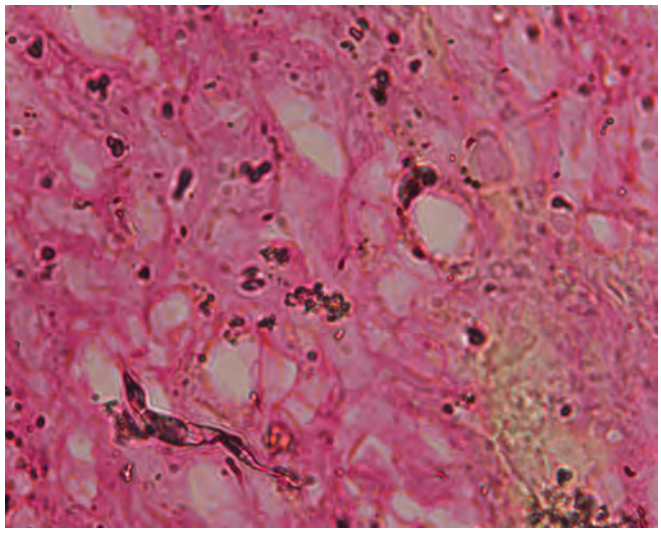

Fig. 5: Postoperative picture after Fontana-Masson staining taken at 100× resolution after 1 year

basal cell layer caused some bleeding spots, which were stopped by laser coagulation mode. Laser ablation of pigmented epithelium immediately produced a melanin pigment-free surface without any carbonization. The lased wound looked fresh with no bleeding. Healing was good in 1 week with pink color comparable to nontreated area resulting in a significant improvement in esthetic appearance. Complete epithelization takes place after 2 weeks. There is slight pain observed after 24 hours in 2 cases. Slight burning sensation during laser irradiation in 2 cases. The color of gingiva is pink. The color was observed in 1, 6, and 12 months following the completion of therapy. All patients showed satisfactory results throughout entire examination period.

Histological Examination

Before irradiation, the pigmentation consisted of melanin granules in the basal cell layer with Fontana-Masson staining. After 1 year no melanin granules were observed in 3 cases, but slight melanin granules were observed in 2 cases.

DISCUSSION

Gingival hyperpigmentation is caused by excessive deposition of melanin located in the basal and suprabasal cell layers of the epithelium. Various depigmentation techniques have been employed using both nonsurgical and surgical procedures, such as scalpel surgery, free gingival autografting, cryosurgery, electrosurgery, chemical agents, such as 90% phenol and 95% alcohol, abrasion with diamond burs, and lasers like Nd:YAG laser, diode laser, and CO_2 laser. Lasers are new in the field of dentistry and have been used in the field of periodontics for removal of calculus, soft tissue excisions, depigmentation, curettage, mucogingival surgeries like frenectomies, operculum removal, coagulation of graft donor site, exposure of soft tissue covering osseointegrated implants, etc. Among the most widely used soft tissue lasers are the diode lasers, which are manufactured from semiconductor crystals using some combination of aluminum or indium, gallium, and arsenic. The laser is used for depigmentation of the gingiva because the wavelength of the laser is highly absorbed by the pigmented tissue containing hemoglobin, melanin, and collagen chromophores and little absorbance by the hard dental tissues. Therefore, this wavelength is safe and well indicated for: (1) Soft oral tissue surgeries in regions near dental structures, (2) cutting, (3) vaporization, (4) curettage, (5) blood coagulation, and (6) hemostasis. The available wavelengths of dental use range from 800 nm for the active medium containing aluminum and to 900 nm for the active medium composed of indium.[17]

In this study, the SCD laser proved to be effective for removal of melanin pigmentation. All patients showed a normal appearance after following treatment. Difficulty was incurred when removing melanin in the gingival papilla region. This may be due to high activity of pigmented cells in the area and the shorter treatment time for full depigmentation in SCD laser. Pain reduction after laser application may be attributed to the protein coagulum formed on the wound surface acting as biologic dressing.

According to Azzeh,[18] the advantages of laser use are a relatively bloodless postsurgical course, sterilization of wound site, minimal swelling and scarring, little mechanical trauma reduction of surgical time and high patient acceptance. However, Lagdive et al[17] stated that the desired success of periodontal treatment without damage to surrounding tissues was obtained, with the

appropriate laser parameters, such as power energy, energy density, and time of irradiation have to be used. Therefore, in the present study, throughout the depigmentation procedure, the laser was cautiously used to avoid injury to the tooth surface and adjacent tissues. In addition, the thin gingival tissue around the root prominence was ablated gently.[19]

Repigmentation

In the present study, repigmentation was only observed in 2 cases out of 5 cases. Hirschfeld and Hirschfeld[5] used 90% phenol and 95% alcohol to remove areas of hyperpigmentation in 20 patients. Repigmentation soon developed in 3 patients, the rest of the patients had the same results within a short period. Hu et al[20] favored the "migration theory" for the mechanism of repigmentation. Active melanocytes from the normal skin and hair matrix proliferate and migrate into depigmented areas. Dummett[21] defined oral repigmentation as the clinical reappearance of melanin pigment following a period of clinical depigmentation of the oral mucosa as a result of chemical, thermal, surgical, pharmacologic, or idiopathic factors. Tal and Stahl[22] removed pigmented keratinized gingiva in two Jewish Yemanite adult male, who had moderate or heavily pigmented gingiva. After surgery, the exposed lamina propria was covered by the periodontal pack for 7 to 10 days. Healing was uneventful and surgically treated areas in both patients remained depigmented over the first 2 years. After 32 months, some pigmentation was found in one of the patients, and with the exception of two limited sites, the areas were completely pigmented after 7 years. The surgically treated area in the second patient remained depigmented over 8-year follow-up period. Bergamaschi et al[23] reported a complete recurrence of gingival pigments after 3 years of follow-up after a gingivectomy procedure. Tamizi and Taheri[24] reported repigmentation 1 year after using a free gingival graft for depigmentation. Nakamura et al[25] reported that despite the lack of recurrence during the first year of follow-up, there was repigmentation in 4 of the 7 cases treated by CO_2 laser, almost equal to the postoperative state, at 24 months. Esen et al[26] reported repigmentation in two cases out of 10 during 24 months follow-up after using the superpulsed mode of a CO_2 laser.

In the present study, repigmentation was observed in one smoker patient after 12 months. Smoking activates the melanin production as well. However, the severity of pigmentation was less than before treatment. The exact mechanism of repigmentation is not known, but according to migration theory, active melanocytes from adjacent pigmented tissue migrated to treated area causes failure.[27]

CONCLUSION

This clinical and histological study indicates that SCD laser can be easily and effectively used for removal of gingival hyperpigmentation. However, esthetic outcome may not last in the long-term.

CLINICAL SIGNIFICANCE

Semiconductor diode laser is easy and effectively used for removal of gingiva hyperpigmentation. Ablation of gingival hyperpigmented areas was accomplished without any bleeding complication or slight pain or no pain observed, which provide clean field during time of procedures, with uneventful healing without any complication. No recurrence or slight recurrence of pigmentation had been found in 12 months follow-up.

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