

## GINGIVAL DEHYPERPIGMENTATION BY USING CARBON DIOXIDE LASER AT CAN THO UNIVERSITY OF MEDICINE AND PHARMACY HOSPITAL, VIETNAM

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### ABSTRACT

**Background:** *Gingival hyperpigmentation frequently poses an aesthetic problem, especially in patients with a gingival smile. Gingival depigmentation treatment is to melanin hyperpigmentation from the gingival. Objectives:* *To evaluate the treatment efficacy of gingival hyperpigmentation by using CO<sub>2</sub> laser. Materials and methods:* *A cross sectional descriptive study was carried out in 38 patients at the clinical practice department of Faculty of Odonto-Stomatology, Can Tho University of Medicine and Pharmacy Hospital, Vietnam. Pain assessment was done using Visual Analog Scale (VAS), in which gingival and plaque indices were used to evaluate the efficacy of oral hygiene after the laser treatment. In addition, clinical evaluation (i.e., gingival bleeding and wound healing) of each treatment procedure was conducted using the bleeding score of 1-4 and the 3-level Dummett–Gupta Oral Pigmentation Index (DOPI) assessment. Results:* *Our results showed that less pain was experienced by patients when a CO<sub>2</sub> laser was used, the rates of no pain, mild pain, moderate pain after treatment were respectively 21%, 76%, 2.6%; 100% complete epithelization after 1 week. The the Dummett–Gupta Oral Pigmentation Index (DOPI) rates of turning from DOPI score 1, 2, 3 to DOPI score 0 after 12-week treatment were 87.5%, 76.9% and 24%, respectively. Conclusions:* *The application of CO<sub>2</sub> laser appears to be a safe and effective procedure for the treatment of gingival melanin pigmentation.*

**Keywords:** *Gingival hyperpigmentation, melanin, CO<sub>2</sub> laser, DOPI.*

### I. INTRODUCTION

Smile aesthetics are related to teeth, lips, and especially the color of gingival tissue. A beautiful smile must ensure that gingival tissue is rosy or pink every time when smiling. Gingival hyperpigmentation frequently poses an aesthetic problem, especially in patients with a gingival smile. An excessive smile accompanied by an unattractive gingival color, also known as a black gummy smile (black-gummy smile) will result in a lack of confidence in communication, especially in thoughtful people. The gingival appearance has an important role in the quality of life of patients such as esthetics, communication [2]. Nowadays, expectations of aesthetics have become more important. Therefore, gum pigmentation, especially in areas uncovered by a smile, has become a frequent reason for consultation [6]. Melanin, melanoid, oxyhemoglobin, reduced hemoglobin, and carotene are popular pigments involved in gum pigmentation. Gingival hyperpigmentation generally results in the overproduction of an endogenous pigment which is melanin [5].

Gingival depigmentation has been a treatment for removing melanin hyperpigmentation from a gingival. Various methods have been used for this procedure with varying degrees of success, including scalpel [3], electrosurgery [4], gingival resection, CO<sub>2</sub> laser [1], [5], diode laser [6], laser Er,Cr:YSGG [7]. These methods have their own advantages and disadvantages, however, mastering a technique and skill proficiency bring the effective treatment of hyperpigmentation. The importance of a good smile cannot be underestimated in the enhancement of the beauty, self-confidence and personality of a person. The CO<sub>2</sub> laser has been used for the gingivectomy, gingivoplasty, frenectomy,

incisional and excisional biopsy, soft tissue tuberosity reduction, operculum removal, coagulation of graft donor sites, and exposure of the soft tissue covering osseointegrated implants[1]. CO<sub>2</sub> laser surgery of the oral soft tissue is generally performed with a power setting of 5 to 15 watts in either a pulsed or continuous mode [1].

The health and appearance of the gingiva are an essential part of an attractive smile. Gingival pigmentation gives rise to the unesthetic smile line. Today, with increasing awareness of esthetic, people have become highly concerned about black gums. Various treatment modalities like abrasion, scrapping, scalpel technique, cryosurgery, electrosurgery and laser are available for the treatment of gingival pigmentation. This study was performed to evaluate the effects of the CO<sub>2</sub> laser applied for gingival depigmentation.

## **II. MATERIALS AND METHODS**

### **2.1. Study population**

The study was carried out from March 2020 to January 2021. The study population consisted of 38 healthy subjects, who complained of black gums and requested any cosmetic correction. Subjects were recruited from the outpatient section, Faculty of Odonto-Stomatology, Can Tho University of Medicine and Pharmacy Hospital, Can Tho city, Vietnam. Written informed consent was obtained from those who agreed to participate voluntarily. Ethical clearances were obtained from the institution's ethical committee and review boards.

Subjects were included all 10 teeth in the maxillary from tooth 15 to 25 that exhibited moderate to severe melanin pigmentation, in the maxillary anterior gingiva from canine to canine (aesthetic zone). Patients with the habit of smoking or use of any other oral substance abuse, presence of gingival recession, missing teeth in the anterior region, patients on any form of Non-Steroidal Anti-Inflammatory Drug (NSAIDS), pregnant and lactating mothers and patients with any systemic involvement were excluded from the study.

### **2.2. Study methods**

The degree of melanin pigmentation was determined by the melanin pigmentation index based on the following scoring system: Score 0: No pigmentation; Score 1: Solitary unit(s) of pigmentation in papillary gingiva without extension between neighbouring solitary units; Score 2: Formation of continuous ribbon extending from neighbouring solitary units [4].

Melanin pigmented gingiva were ablated by CO<sub>2</sub> laser vaporization under local anesthesia. The gingival chromosome condition was captured using a lip ball in dentistry to observe clearly the anterior gingival tissue. Photographs of gingival tissue were taken using Canon 70D camera, 50-mm focal length, aperture f11, ISO 100 with ring flash. All photos were taken by a camera, with the same focal length, light intensity, and the distance from the camera to the study subject of 30 cm. The procedure was repeated until the desired depth of tissue removal was achieved. Adjacent teeth were protected from the laser beam by applying an acrylic template to cover the labial surface of the teeth.

After completion of each procedure, the operated area was finally cleaned with gauze soaked with normal saline, and no dressing was given in any of the treated sites. The patient was instructed to avoid spicy, hard, sour and hot food, avoid smoking and brushing on the treated area, maintain oral hygiene by regular rinsing after meals, and advised to use warm saline rinses from the next days. The post-operative evaluation was carried out on the 1<sup>st</sup>, 7<sup>th</sup> day, and subsequently after 21 days from the depigmentation treatment. Pain

assessment was done using Visual Analog Scale (VAS) and the gingival and plaque indices to evaluate the efficacy of oral hygiene after the treatment. In addition, the clinical evaluation of gingival wound healing was used (0: tissue defect or necrosis; 1: ulcer; 2: incomplete or partial epithelisation; 3: complete epithelization). Patient preference for each procedure was recorded. The bleeding score from 1 to 4 was recorded; the Dummett–Gupta Oral Pigmentation Index (DOPI) index was recorded with 4 levels as follows, DOPI score 0: No clinical pigmentation (pink-colored gingiva); DOPI score 1: slight hyperpigmentation, light brown tissue; DOPI score 2: moderate hyperpigmentation, medium brown tissue, or a blend of pink and brown; DOPI score 3: severe hyperpigmentation, dark brown or green / black tissue. The healing of the gingival was recorded: tissue damage, necrosis, incomplete and partial epithelization, and full epithelialization [8].

Statistical analysis was conducted using SPSS 22.0 for Windows and by comparison the preoperative data of the pigmented area with that of postoperative data after 4 weeks from treatment day. This research was approved by the Ethics committee of Can Tho University of Medicine and Pharmacy.

### III. RESULTS

Among studied subjects, 50.0% of participants were males and 50.0% were females. The average age was 22.75 age years (SD = 0.93), with 97.4% in the 20 to 24 years age range

Ablation of the pigmented gingiva was accomplished without any bleeding. No charring or carbonization occurred during the procedure. None of the patients required repetition of the procedure in the early postoperative period. Healing was completed in 4 weeks without any scar formation, which resulted in a significant improvement in esthetic appearance. No infections or significant postoperative complications were encountered.

#### 3.1. Pain after treatment

**Table 1.** Pain at various time after melanin pigmentation treatment using CO<sub>2</sub> laser

| Variable pain (n, %) | Time (n, %) |          |           |           |
|----------------------|-------------|----------|-----------|-----------|
|                      | 1 day       | 1 week   | 4 weeks   | 12 weeks  |
| No                   | 8 (21%)     | 37 (97%) | 38 (100%) | 38 (100%) |
| Mild                 | 29 (76%)    | 1 (2.6%) | 0 (0%)    | 0 (0%)    |
| Moderate             | 1 (2.6%)    | 0 (0%)   | 0 (0%)    | 0 (0%)    |
| Severe               | 0 (0%)      | 0 (0%)   | 0 (0%)    | 0 (0%)    |

The results of pain analysis in **Table 1** indicate that there was not severe pain after the treatment procedure. After 1 day of treatment, number of cases with no pain, mild pain and moderate pain were 8, 29, and 1, respectively. There was 1 patient with mild pain after 1 week.

#### 3.2. Healing after treatment

**Table 2.** Healing after the treatment

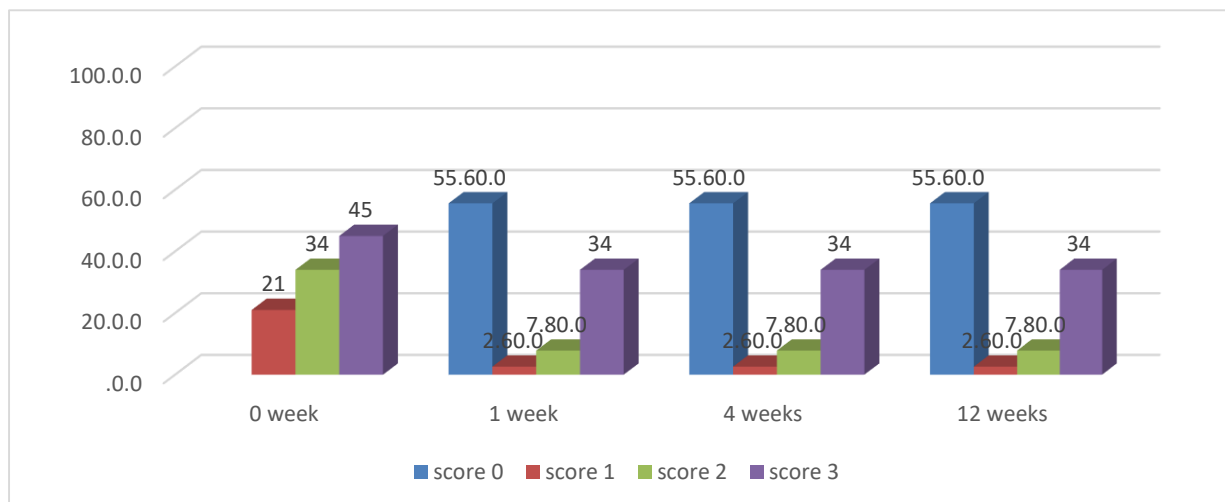
| Variable healing (n, %)               | Time (n, %) |          |          |
|---------------------------------------|-------------|----------|----------|
|                                       | 1 day       | 1 week   | 4 weeks  |
| Tissue damage                         | 0 (0%)      | 0 (0%)   | 0 (0%)   |
| Necrosis                              | 0 (0%)      | 0 (0%)   | 0 (0%)   |
| Incomplete and partial epithelization | 38(100%)    | 0 (0%)   | 0 (0%)   |
| Full epithelialization                | 0 (0%)      | 38(100%) | 38(100%) |

Results of wound healing showed that, all the 38 cases only presented partial

epithelization after 1 day treatment, meanwhile all cases obtained completely healing after 1 and 4 weeks treatment.

### 3.3. Gingival pigmentation according to DOPI after treatment

The changes in DOPI indices from baseline to 3 months were 55.6% for surgical stripping sites for CO<sub>2</sub>-laser-treated sites.



**Figure 1.** DOPI score after gingival pigmentation treatment using CO<sub>2</sub> laser at various duration of 1, 4, 12 weeks



(A) Before treatment - DOPI score 3



(B) 1 week treatment- DOPI score 1



(C) 4 weeks treatment - DOPI score 1



(D) 12 weeks treatment - DOPI score 1

**Figure 2.** Gingival depigmentation follows up 12 weeks

## IV. DISCUSSION

In this study, we used a saline swab to scrub and remove the chromosome epithelium. We found a few small spots bleeding from the swab, but there was no bleeding after the treatment. Hedge *et al.* (2013) [4] used Er: YAG laser with processing conditions of the wavelength of 2.940 nm, energy 180 mJ, 10 Hz, the power level of 1.8 W, long pulse, non-contact. The laser beam was guided in a “brushstroke” pattern until the entire area was free of pigmentation. The authors also observed some bleeding points during the operation, and then there was not bleeding anymore [4]. An explanation for the non-swelling mechanism as using CO<sub>2</sub> laser is that a laser wound is not a burn, but it induces almost instantaneous evaporation of the fluid in the cells, which disintegrates the cellular structure.

Such cell destruction may not release inflammatory chemical mediators. At the same time, the evaporation of extracellular fluid induces the denaturation of protein structure. A thin modified collagen layer on the surface of the laser-illuminated area can act as an impermeable zone in the immediate post-laser phase, and thus reduce the level of tissue irritation from substances in the mouth. Blood vessels with a diameter of 0.5 mm will be sealed, and coagulation takes place to help the wound dry [5].

In this study, we do not use local infiltration anesthesia in the laser-treated area, but lignocaine spray was applied to the operating area. Hedge *et al* (2013) [4] also found that the patient was no pain after melanin hyperpigmentation treatment using Er:YAG laser for 24 hours and 1 week. In contrast, a study comparing two laser projection methods (i.e. Er:YAG and CO<sub>2</sub> laser) on each group of 10 patients showed that the patients treated using Er:YAG laser had a slight pain sensation (0.1-3.0), while the patients treated using CO<sub>2</sub> laser reported pain on a Visual Analog Scale (VAS) scale from mild to moderate (0.1-3.0, 3.0-6.0), and 2 patients complained of severe pain (6.1-10). An explanation for less pain in the Er:YAG laser (2940 nm, 180 mJ, 10 Hz, total power of 1.8 W, long pulse) is the gingival surface has a dense dry protein network that acts as a biofilm to seal the nerve endings. Er:YAG rays have a lower energy level than that of CO<sub>2</sub> beam. Besides, the beam depth is only 1 µm so it is less or painless compared to CO<sub>2</sub> lasers (10,600 nm, 2-4 W). CO<sub>2</sub> laser energy is well absorbed in water. As oral mucosa contains a very high water percentage, this makes the CO<sub>2</sub> laser ideal for precise, safe ablation with good haemostasis [8].

During the first week, flaking of the fibrin layer was observed and completed, and consequently re-epithelialization occurred. The gingival appears healthy, with no infection, swelling, and scarring. After the second week, the translucent and non-keratinized epithelium is visible, and the color of the gums becomes reddish in comparison to the untreated neighbouring areas. After the fourth week, the gingival area was already the same color as the normal untreated gingival area [9].

CO<sub>2</sub> laser has the advantages in the treatment of gingival melanin pigmentation such as: not bleeding, not causing deformation or concave of the gingival tissue surface, especially in the position of the marginal gingival or interdental gingival. However, we found that the CO<sub>2</sub> laser is not very effective to remove all the melanin deep layer. Connective tissue at the basal membrane close to the periosteal membrane with 1 saline swabs under an epithelial-peel mechanism, in addition to a CO<sub>2</sub> laser leaving coals at the gingival sites [5].

The recurrence of the marginal gingival and a few small gingival spots in our study are similar to that of Kishore *et al.* (2014) [3], possibly due to the high activity of residual pigment cells, the movement and proliferation of these cells is called the "Migration effect", which remains pigment cells [8]. Rasmhi *et al.* (2013) [2] reported that the recurrence rate after gingival hyperpigmentation using CO<sub>2</sub> laser was 10 positions, which accounted for 28.5% after 6-months treatment, and recurrence started for about 3 months after the treatment [5].

## V. CONCLUSIONS

Considering the results of this study, it can be concluded that the application of super-pulsed CO<sub>2</sub> laser appears to be a safe and effective method for the elimination of gingival melanin pigmentation. It is worthy to note that the esthetic outcome may not last in the long term.

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