Comparison between diamond bur and diode laser to treat gingival hyperpigmentation

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Abstract. Gingival hyperpigmentation can be treated using a diamond bur or a diode laser. This research aimed to compare both techniques in terms of wound healing rates and pain experienced by patients. We used the split-mouth technique to treat gingival hyperpigmentation in 19 individuals. We recorded clinical parameters such as the degree of pain using Visual Analog Scale and the speed of healing using the PUSH (pressure, ulcer, scale, and healing) criteria. Our results showed that wound healing rate was faster and less pain was experienced by patients when a diode laser was used. We found that using a diode laser resulted in significantly less pain and faster healing rate than using a diamond bur for gingival depigmentation.

1. Introduction

A smile expresses happiness, success, sensuality, affection, confidence, and kindness [1]. A smile is a way of communication and is a tool of socialization and attraction. The harmony of a smile not only depends on its shape, position, and color but also on gingival appearance [2]. According to a study, 50% of people claim that the appearance of a smile is more important than that of the face, and by now smile makeovers are a lot more common than other facial esthetic treatments [3].

The gingiva plays a big role in making a smile more attractive. Melanin hyperpigmentation of the gingiva occurs as the result of abnormal melanin deposition and affects all races, ages, and sexes [1, 3]. Melanin pigmentation is a multi-factorial process that can involve physiological and pathological factors. Melanin pigmentation can be caused by genetic factors or by systemic or local conditions such as smoking or long-time medication use (antimalarial and tricyclic antidepressants) [4, 5]. The condition does not cause any medical problems, yet esthetically, it causes discomfort because the pigmentation can be seen when the individual speaks or smiles (especially in those with a gummy smile). Esthetic problems also affect people with moderate to severe melanin pigmentation [1, 3, 6].

Gingival depigmentation is a plastic surgical procedure whereby gingival hyperpigmentation is eliminated using one of various techniques. The first indication for the procedure is the individual’s request for esthetic enhancement. The choice of techniques should be based on individual clinical outcomes and preferences [7]. Techniques used in the past include chemical cauterization [8],...
gingivectomy [9], scalpel scraping procedure [10], and gingival ablation [11]. The latest techniques are cryotherapy [12], free gingival autografts [13], and laser therapy [14].

The procedure of gingival ablation using a diamond bur is simple and effective and does not require sophisticated and long-lasting tools compared with other surgical techniques [4, 7, 11, 15]. Laser use was once considered expensive and was rarely available in the dentistry clinics, but now >20% of dentistry clinics regularly use dental lasers. Research and innovation in the field of dentistry lasers has led to improvements in the ease with which the device is used [16]. Laser techniques, although still a developing technology, have already shown plenty of evidence for their effectiveness and efficiency, giving a strong reason to use it in dentistry. Of the various types of lasers available for gingival depigmentation, diode lasers have several advantages, including their small size, affordable price, and diversity in terms of soft-tissue treatment applications, making them of great value to a dental practice [17].

2. Methods
This research was a clinical experiment using single-blind, split-mouth, and randomized designs. The subjects were individuals with gingival hyperpigmentation who visited Teaching Dental Hospital, Faculty of Dentistry, Universitas Indonesia, in January to March of 2013. The participants were assigned numbers. Individuals with gingival hyperpigmentation measured using a melanin pigmentation index in the labial region of the maxilla; who were aged 20–55 years; and who were in a good general health were included. Patients with systemic conditions or diseases related to healing disorders, those with malignant melanoma, Peutz–Jeghers syndrome, hemachromatosis, or chronic pulmonary disease and also those taking medications such as doxorubicin, busulfan, or cyclophosphamide were excluded from the study.

Gingival depigmentation was planned from the second premolar to the left first incisor using a high-speed handpiece and straight diamond bur (No. 8) with copious water lavage. The largest diamond bur was used, as the small bur does not easily smooth the surface and has a tendency to make small holes in the healing area. Feather-like strokes were used to remove the pigmented epithelium area without burden retention. Coe-pack dressings were placed at the operating site, and patients were given analgesic.

Depigmentation of the second right premolar region to the first right incisor was performed using a semiconductor diode laser unit (Nvlaser or AMD laser, USA) set at 810 nm, 2 W, and in continuous mode with 400 μm of optical fiber end. The laser tip was held slightly above the target tissue and the laser beam was directed with one quick movement so as to induce blister formation. The blistered gingiva was then removed using wet cotton to remove the epithelium containing melanin. No antibiotics were given to any of the subjects.

Clinical parameters for pain were recorded using a Visual Analog Scale on the first day and again in the first week after the procedure, while the wound healing rate was evaluated in the first, second and third weeks after the procedure using the PUSH criteria: pressure, ulcer, scale, and healing.

3. Results
There were 19 patients aged 18–55 years with physiological gingival hyperpigmentation treated in this study.
Table 1. Evaluation of wound healing rate after treatment using diode laser or diamond bur in the first, second, and third week after the procedure.

| Healing (N = 38) | 0     | 1     | 2     |
|-----------------|-------|-------|-------|
| **First Week**  |       |       |       |
| Diode Laser     | 16 (84.2%) | 3 (15.8%) | 0 (0%) |
| Diamond Bur     | 1 (5.3%) | 12 (63.2%) | 6 (31.6%) |
| **Second Week** |       |       |       |
| Diode Laser     | 19 (100%) | 0 (0%) | 0 (0%) |
| Diamond Bur     | 17 (63.2%) | 2 (36.8%) | 0 (0%) |
| **Third Week**  |       |       |       |
| Diode Laser     | 19 (100%) | 0 (0%) | 0 (0%) |
| Diamond Bur     | 19 (100%) | 0 (0%) | 0 (0%) |

Description: 0 = Perfect epithelization: wound covered by the epithelium; 1 = Incomplete epithelization/re-epithelization: shiny pinkish layer on the surface of the wound; 2 = Granulated: pink, moist, and granulated dull tissue.

The results of the data analysis showed marked differences in healing rate after the two depigmentation procedures (Table 1). The differences were noticeable starting on the first week after the procedure when almost all sides treated with the diode laser had already healed and only 1 on the diamond bur side had done so. All gingivas on the diode laser side had healed by the second week, whereas less than half on the diamond bur side had complete re-epithelization. Finally, by the third week, all patients had healed completely.

Table 2. Cross-tabulation of pain experience on the first day after treatment using either diode laser or diamond bur.

| Variable      | No pain | Mild Pain | Moderate Pain | Total | P     |
|---------------|---------|-----------|---------------|-------|-------|
| Diamond Bur   | 1 (5.9%) | 8 (72.7%) | 10 (100%)     | 19 (50%) | 0.000 |
| Diode Laser   | 16 (94.1%) | 3 (27.3%) | 0 (0%)     | 19 (50%) |       |
| **Total**     | 17 (100%) | 11 (100%) | 10 (100%) | 38 (100%) |       |

Chi-Square test; P < 0.005; there is statistically significant difference

The results of the analysis in table 2 indicate that there was a significant difference (P < 0.05) in the pain experienced one day after depigmentation between the diamond bur and diode laser procedures. On the first day, almost all patients experienced some pain on the diamond bur side, while almost all of the patients reported no pain on the laser-treated side. This showed that the laser diode treatment produces less pain than the diamond bur procedure in the treatment of gingival hyperpigmentation.

Table 3. Pain experience after a week of the depigmentation treatment using either laser diode or diamond bur

| Variable      | No pain | Mild Pain | Moderate Pain | Total |      |
|---------------|---------|-----------|---------------|-------|------|
| Diamond Bur   | 19 (50%) | 0 (0%)   | 0 (0%)       | 0 (0%) |     |
| Diode Laser   | 19 (50%) | 0 (0%)   | 0 (0%)       | 0 (0%) |      |
| **Total**     | 38 (100%) | 0 (0%) | 0 (0%) | 0 (0%) |      |
The results of the analysis in Table 3 indicate that there was no difference on the pain experienced during the depigmentation procedure using diamond burs and laser diodes a week after treatment.

4. Discussion

4.1. Subject characteristics

Subject in this study were individuals aged 18–50 years with physiological hyperpigmentation disorders on the maxillary labial surface. The minimum age selection was based on the FDA (US Food and Drug Administration) guidelines, which state 18 as the minimum age for patients to undergo plastic surgery, while the determination of the maximum age limit coincided with the decrease in physiological functions associated with anesthesia application [18].

4.2. The rate of healing in gingival hyperpigmentation treatment using diamond bur and diode laser

The results of this study showed that treatment using diode lasers promote faster healing rate than that using diamond bur in the first and second weeks. This occurs because the diode laser provides a biostimulation effect that increases the proliferation of fibroblasts, and fibroblasts are the precursor cells of connective tissue structures such as collagen, epithelial cells, and chondrocytes. A study using diode lasers in soft-tissue lesions in vitro and in vivo reported enhancement of tissue stimulation seen as increased granulation tissue, accelerated epithelialization, increased proliferation of fibroblasts, increased matrix synthesis, and improved vascularization. These results are in line with Borchers’ study that showed a healing rate of 57.14% by evaluating the fibrin layer after 1 week. The faster the fibrin layer disappears, the faster the healing takes place. In addition, D’Arcangelo et al.’s study found that all otherwise healthy tissues treated using diode lasers heal within 7 days [19].

Gingival depigmentation using diamond burs results in slower healing because the tissue injury is more difficult to control, creating a non-smooth irregular surface in the gingiva. This can lead to the extravasation of blood and lymph fluids that cause prolonged swelling. This does not occur in laser diode treatments that have adequate hemostasis, proper incision margins, and acceleration of the inflammatory phase so that swelling is reduced. All of these play a part in the increase of the healing rate.

Three weeks after the gingival depigmentation, there is a process of continuous healing with squamous epithelial cell proliferation; histologic examination shows either inflammatory cells or tissue damage under hematoxylin & eosin. By the third week of our study, all procedures had completely healed. This result is similar to that of a study conducted by Anastasios et al., who showed that the healing processes after depigmentation using laser diodes, scalpels, and diamond burs showed complete epithelization after 3 weeks. The same was true of a study conducted by Rakhul et al that used scalpel, bur abrasion, or electro surgery for depigmentation. A complete epithelialization after 3 weeks was also found in a study by Roshna et al., which also used diamond burs for gingival depigmentation [20].

4.3. Pain experience during gingival hyperpigmentation removal using diamond bur and diode laser

The results of our cross-sectional test showed that there was a statistically significant difference (p = 0.000) between the two treatments in terms of pain during the procedures, with many patients experiencing no pain during the diode laser treatment.

Reduced or absent pain during diode laser treatment can occur due to the way the laser affects the peripheral nerve activity, which gets enclosed by coagulated proteins causing a significant decrease in the velocity of the sensory nerve conduction. This explains the pain reduction of the laser procedure. Another explanation for the little pain produced by the diode laser may be the stimulation of anti-inflammatory effects and the neurohumoral response (serotonin, norepinephrin). Our results are consistent with those of Göksel et al. who found no discomfort for patients during or after diode laser depigmentation despite using only topical anesthesia [21]. Conclusions from the study by Roshna et al.
also stated that the technique of removing gingival hyperpigmentation by lasers and cryosurgery was less painful than others [20].

5. Conclusion
The healing process in the first and second weeks after gingival hyperpigmentation using a diamond bur is slower than the treatment using diode lasers, although all our treatments had completely healed by the third week. The pain experienced in the first day after treatment was greater in the treatment sides using diamond bur. Our patients experienced no pain 1 week after treatment using either technique.

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