Gingival Depigmentation Using an Er,Cr:YSGG Laser: Two case reports with 2-year Follow-up

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**Abstract**

**Objective:** This report described the procedure to remove dark gingival pigmentation that is a common esthetic problem using an Er,Cr:YSGG laser. A longer follow-up period than previous reports assessed the relapse of pigmentation.

**Clinical Considerations:** Two patients presented gingival melanin pigmentation in the maxillary anterior sextant. An Er,Cr:YSGG laser with wavelength 2,780 nm and a sapphire tip was used to treat the gingival pigment under topical anesthesia at power setting 1.75 and 2.0 W with short pulse mode. The SpectroShade® reported CIELAB values which refer to as $L^*a^*b^*$, expresses color in 3 values. At the 1-month follow-up, a reduction in pigmented areas was observed. At the 2-year follow-up, some repigmentation was observed. However, the gingival color in both cases was still lighter than pretreatment according to higher $L^*$ values. Both patients were satisfied with the results and reported none postoperative complications.

**Conclusion:** The Er,Cr:YSGG laser was effective for gingival depigmentation. Some relapse of pigmentation occurred but with less intensity than before treatment at the 2-year follow-up. The effectiveness and some relapse were observed visually and by numeric parameter.

**Introduction**

Dark gingival pigmentation is a common esthetic problem. Racial pigmentation occurs in varying degrees. The gingiva is the most frequently pigmented intraoral tissue[1]. Melanin, produced by melanocytes in the basal and spinous layers of the gingival epithelium is the most common physiologic pigmentation[2] and normally manifests on the labial attached gingiva[3]. Various methods are used for depigmentation[4]. Surgical methods include scalpel surgery[5-7], bur abrasion[8, 9], electrosurgery[5, 10], cryosurgery[8, 11, 12], laser[13-17, 21-28] and free gingival graft[1, 18, 19]. Chemical methods are also available[20].

Lasers including Nd:YAG[13, 17], CO2[14], Er:YAG[14], diode[15, 16] and recently Er,Cr:YSGG[21-28] have all reported good results. Laser therapy is more comfortable for the patient compared with the other techniques[4]. Although rare, complications resulting from laser treatment have been reported[17, 22, 23]. An Er,Cr:YSGG laser device (Waterlase MD/Biolase® Technology, Inc., Irvine, CA, USA) operates at 2.78 µm wavelength, frequency of 10 to 50 Hz, power of 0.1 to 8.0 W and pulse energy 0 to 300 mJ. Limited publications exist concerning Er,Cr:YSGG depigmentation[22-29]. Reports of repigmentation varied with individuals and techniques[1, 30]. Repigmentation occurs as a result of the migration of active melanocytes from the surrounding tissue to the treatment site. Using Er,Cr:YSGG reports indicated none to partial recurrence[4,
22-28]. This is the first long-term follow-up report 2 years after using the Er,Cr:YSGG laser.

In addition, a dental spectrophotometer (SpectroShade® Micro, MHT S.r.l. a socio unico Via Enrico Fermi 22, 37135 Verona (VR) – ITALIA) was used to evaluate the gingival color changes besides visual observation. A referenced transparent plastic sheet was used with the SpectroShade® at 2 selected pigment areas in each patient in order to compare between different time frame. The SpectroShade® reported CIELAB values[31]. The CIELAB values, refer to as L*a*b*, expresses color in 3 values: L* represents the lightness value (0 for absolutely black to 100 for absolutely white), a* represents the chromaticity coordinate for red–green axis (positive a*=red color range; negative a*=green range), and b* represents the chromaticity coordinate for yellow–blue (positive b*=yellow color range; negative b*=blue color range). Then average L*a*b* values of each case was calculated manually.

Clinical presentation

Two Asian patients presented unesthetic gingival hypopigmentation in the maxillary anterior area. All cases denied systemic disease or smoking. The procedure and possibility of repigmentation were explained. All patients provided consent before commencement of treatment.

Case management

Before the procedure, patients were given oral prophylaxis and oral hygiene instruction. A 20% benzocaine gel (Alpha-Caine®) was applied both before and during the procedure. An Er,Cr:YSGG laser device with a laser tip (MC12 Sapphire), 1.2 mm diameter, was used in non-contact mode in a sweeping motion at ~2 mm from the gingiva. The power setting was 1.75-2.0 W, frequency 40 Hz with short pulse duration (H mode, 140 µs), 7% water and 11% air. The average power of this setting was 1.75-2 W since the tip had a calibration factor of 1. The energy density was 0.01 J/cm². Then, a laser setting of 0.5 W, 0% water and 20% air was used as a bandage. No analgesic prescriptions were given. All patients returned for post-operative care after treatment. If any pigmentation remained at the treated areas, the procedure was repeated at 2-week follow-up. All patients were reevaluated at 1, 3, 6 and 24 months. The L*a*b* values of each case was repeated and then the average was calculated manually at 1 and 24 months.

Case 1

A 24-year-old female had slightly brown melanin hyperpigmented gingiva (Fig. 1a), suggesting class II D0P1[30] and L* value was 40.2. The Er,Cr:YSGG setting was 1.75 W.

Figure 1a: Preoperative view.
Figure 1b: Immediately after depigmentation at tooth #6 to #8 area compared with untreated area at tooth #9 to #11.
Figure 1c: Healing 1 week after the first treatment.
Figure 1d: Healing 1 month after the second treatment
Figure 1e: 6-month follow-up.
Figure 1f: 2-year follow-up.
Clinical results

Immediately after the procedure, the ablated area appeared clean with no bleeding (Fig. 1b). One week after depigmentation, noticeable bleaching of pigmentation was noted. (Fig. 1c). The remaining pigmentation at tooth #8 resulted from awareness of possible gingival recession. A second treatment was performed a week later. A reduction in pigmented areas was observed dramatically at 1-month follow-up. One month later, two ceramic crowns were permanently cemented on teeth #8 and #9 (Fig. 1d) and L* value was 46.7. Six months (Fig. 1e) after depigmentation, slight light brown separated islands were present at the marginal gingiva of tooth #8. Some repigmentation in the interdental and marginal gingiva was seen at the 2-year follow-up (Fig. 1f). According to the numeric parameter (L*), the gingival color was darker at 2 years (43.8) when compared with at 1-month healing. But it was still less intensity than before treatment (43.8 vs 40.2) (Table 1).

Case 2

A 47-year-old female had a gummy smile with dark brown to black gingiva (Fig. 2a), suggesting class III DOPI and L* value was 36.4. A setting of 2.0 W was used.

Clinical results

Immediately after the procedure, the wound displayed small bleeding points. At 2 weeks after the treatment, the second laser procedure was done for the remaining melanin pigment. At 1-month (Fig. 2b) follow-up, the gingiva was pink. At the 6-month follow-up some light brown strips were present, while at the 2-year follow-up, reduced pigmentation intensity was observed in interdental and marginal gingiva (Fig. 2c). When 2-year follow-up was compared to 1-month follow-up, some repigmentation was observed but it was less intensity than before treatment (L*=36.4) (Table 1).

Discussion

This report showed the efficacy of Er,Cr:YSGG for gingival depigmentation. Comparison of Er,Cr:YSGG with a diode laser showed significantly reduced pain levels[26]. The bleeding result directly after surgery with Er,Cr:YSGG was more than with diode laser[26, 27]. Complications were reported after depigmentation using the Nd:YAG laser including gingival recession, gingival fenestration and bone exposure[17]. Bone exposure was reported after Er,Cr:YSGG laser treatment with 1.00-1.75 W[23]. In this report, neither bone exposure nor gingival fenestration was found, even though the power setting was higher (1.75-2.0 W). Tooth sensitivity was reported after an Er,Cr:YSGG was used for depigmentation but this was slight and disappeared within 24 hours[22]. Tooth sensitivity was not an issue in all cases. The second attempt of laser treatment was done in both cases due to heavy pigmentation. The deeper wound generated increased bleeding during the procedure and blood coagulation masked the pigmentation remaining for treatment.

Some studies reported faster wound healing and lesser scar tissue with laser than conventional scalpel surgery. [32,33] On the contrary, other studies reported the delayed re-epithelization of the wound created by laser.[34,35] This report was agreed with a case report by Berk et al [21] that wound from depigmentation procedure with Er,Cr:YSGG laser produced quickly wound healing because the gingiva

Table 1: The CIELAB values at preoperative, 1month, and 2-year post treatment.

<table>
<thead>
<tr>
<th>Case</th>
<th>Preoperative</th>
<th>1-month follow-up</th>
<th>2-year follow-up</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>L*  a*  b*</td>
<td>L*  a*  b*</td>
<td>L*  a*  b*</td>
</tr>
<tr>
<td>Case 1</td>
<td>40.2 28.2 22.2</td>
<td>46.7 27.5 22.8</td>
<td>43.8 26.3 21.75</td>
</tr>
<tr>
<td>Case 2</td>
<td>36.4 23.85 21.1</td>
<td>43.5 21.2 22.7</td>
<td>41.4 21.4 23.7</td>
</tr>
</tbody>
</table>

Figure 2a: Preoperative view.
Figure 2b: Healing 1 month after the second treatment
Figure 2c: 2-year follow-up.
was similar to the normal untreated gingiva at 1 week after the treatment.

Only a topical anesthesia, 20% benzocaine gel (Alpha-Caine®), was applied before and during the procedure. This was the same as most of the studies[21-23, 25, 28]. On the other hand, some reports used infiltration anesthesia[24, 27]. Both patients were comfortable during the procedure.

The laser pulse has two pulse durations: short (60 µs) and long (700 µs). In this report, a short pulse duration was used. Only one previous study compared between 2 laser settings including long and short pulse duration[28] while the others did not report pulse duration used [21-27]. The shorter pulse resulted in greater ablative and lesser coagulative effect. When 4.5W, 80% air and 100% water laser setting was compared with 2.5W, 40% air and 20% water, a better pigmentation removed was demonstrated with a higher power and water spray[28]. Additional lasing was utilized the second time in these 2 cases. Some studies also reported 2 to 3 sessions of Er,Cr:YSGG laser treatment in order to remove residual pigmentation [22,27]. Therefore, if the laser setting with higher power and more water spray was used, the remaining pigmentation should be seen easier during the treatment and the procedure needed not to be repeated.

Er,Cr:YSGG laser is a time-consuming procedure compared to other lasers[26]. The two case treatments required longer chair time, even though the tip diameter in this report (1,200 µm) was larger than for previous reports (600 µm [21, 23] and 800 µm [28]). High intensity is required deep for laser ablation. This report used 1.75-2.0W which was higher than some previous studies[23, 24] but lower than a study by Gholami et al[28]. The higher power setting was a faster procedure than a lower setting (4.5W vs 2.5W) [28].

Patients should be forewarned of the possibility of repigmentation after treatment. Repigmentation but with less intensity than before treatment occurred in all cases at 2 years after treatment. However, the gingival color in both cases was still lighter than pretreatment according to higher L* values. Repigmentation usually appears in the interdental and marginal tissues due to laser manipulation difficulties[36]. Some studies reported repigmentation in 50%-100% of cases at 11-12 months follow-up[23, 28], while others[26] reported no relapse of pigmentation in 40% of the cases after 2 years. No significant differences were recorded among Er,Cr:YSGG, 940 and 445 nm wavelengths diode lasers.

Conclusions

Overall, results indicated that Er,Cr:YSGG laser treatment rendered minimal invasion and was an effective method for gingival depigmentation. A reduction in pigmentation at 2 years was noticeable compared to baseline. Even though some repigmentation was observed, the intensity was still less than before treatment by visual and numeric parameter according to L* from CIELAB value.

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References

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