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Comparison of the Coagulation Effect of Different Types of Laser Crown Lengthening

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Abstract: Lasers are a new alternative to the classical methods for gingivectomy and crown lengthening. Three different types of lasers were used in order to examine their coagulation effect on the gingival tissues – an Er:YAG, a diode and a CO_2 laser. Their advantages and disadvantages vary and the clinicians must be aware of the results in order to choose the best instrument according to the clinical case.

Keywords: Laser, gingivectomy, crown lengthening, histology, coagulation

INTRODUCTION

In their everyday practice dentists encounter cases with excessive gingival overgrowth, altered passive eruption and short clinical crowns, which can be corrected by using surgical techniques. Lasers are a new alternative to the classical resective methods and can be used with great success for all of the indications listed above. Their main advantages are the excellent hemostasis and bactericidal effect. However, the data about the width of the coagulation layer, the presence of stasis of the blood vessels and the degree of rupture of the tissue are scarce.

MATERIALS AND METHODS

In order to examine the effects of lasers on the gingival tissues, nine patients (age 18 to 28 years) underwent clinical crown lengthening by using three different types of lasers – Er:YAG, CO_2 and diode. A histological sample was taken from each one of them, assessing: the presence or absence of a microscopic rupture of the tissue, the presence or absence of hemostasis in-depth and the width of the coagulation layer (in μm). After the procedures a periodontal dressing was used to cover the wounds.

The Er:YAG laser is with a wavelength 2940 nm (LiteTouch, Syneron Dental, Israel). The tissue is evaporated up to the level of the bleeding points, which were pre-marked by using the Crane-Kaplan probe. A thin chisel tip (AS71972, tip diameter – 0.8 mm, length – 17 mm) was used, in a contact mode with water cooling and 15 º angles to the root surface. The settings are as follows: Gingivectomy, 300 mJ, 18 Hz (5.4 W), with incessant water cooling (40%). The other laser parameters are as follows: spot size (beam diameter) – 0.8 mm, pulse width – 410 μs, energy per pulse – 300 mJ, peak pulse power – approx.750 W, power density – 1500 W/cm^2 and fluence – 10.5 J/cm^2.

The CO_2 laser (DSE, Korea) is with a wavelength 10 600 nm, Implant 2nd Surgery Mode, Ultra Dream Pulse Mode with peak power – 252 W, duration – 200 μs and repetition rate – 5 ms (200 Hz). The tissue is evaporated up to the level of the bleeding points in a non-contact focused mode, without water cooling. The spot diameter is 2.5 mm, the power – 10 W, peak pulse power – 250 W, power density – 5000 W/cm^2 and the fluence – 1 J/cm^2.

The diode laser's wavelength is 810 nm and maximum power 8 W (FOX, A.R.C. Lasers GmbH, Germany). The settings are as follows: contact mode, 1.5 W, continuous wave, Gingivectomy Mode, without water cooling. The tissue is evaporated up to the level of the bleeding points. The fiber diameter and the spot size (beam diameter) are 300 μm, the energy density – 2100 W/cm^2 and the fluence – 2100 J/cm^2.

RESULTS AND DISCUSION

The results of the histological assessments are shown in **Figures 1 - 6.**

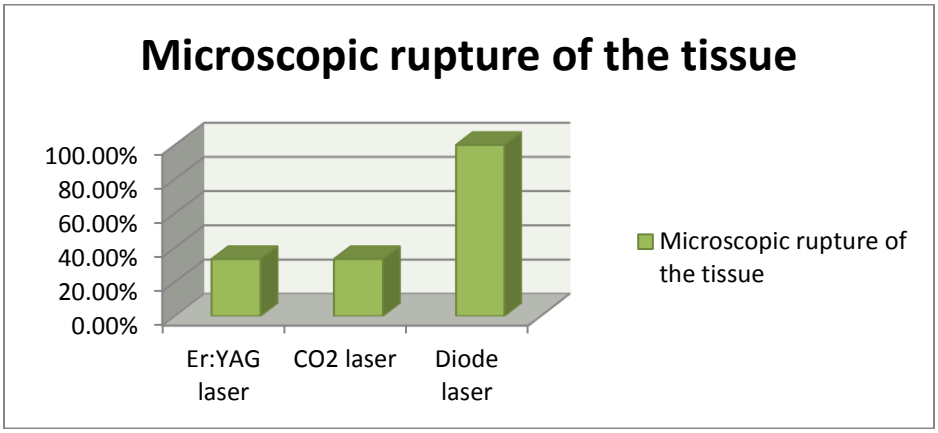

Figure 1. The microscopic rupture of the tissue is present in 100% of the diode laser samples and in 33.3% of the Er:YAG and CO_2 samples.

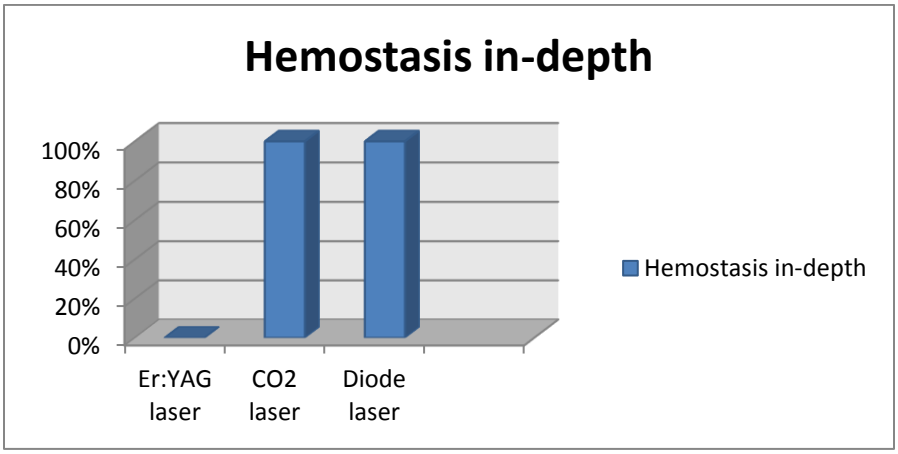

Figure 2. The hemostasis in-depth is present in100% of the CO_2 and the diode laser samples and is absent in the Er:YAG samples.

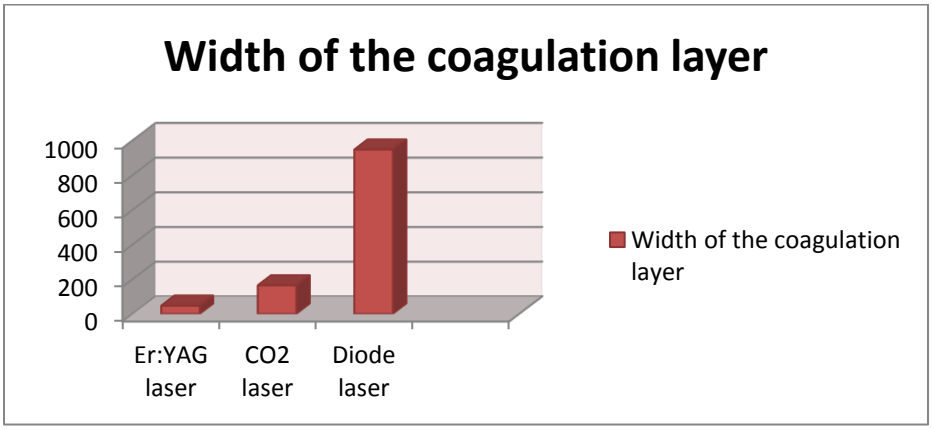

Figure 3. The width of the coagulation layer is as follows: Er:YAG laser – 47,9 ± 16,382 µm; CO_2 laser – 165,11 ± 36,440 and diode laser – 948,33 ± 170,990 µm.

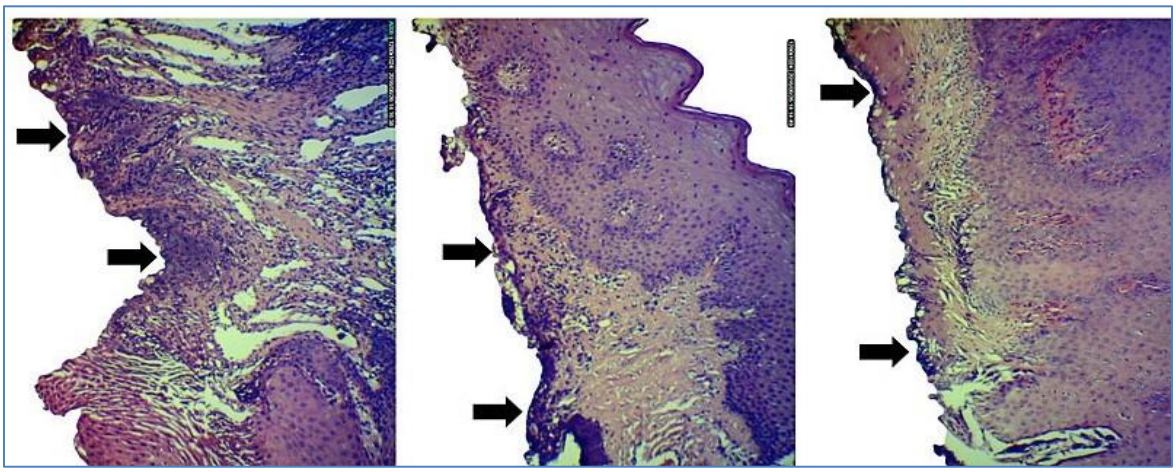

Figure 4. Histological samples of an Er:YAG laser. The left side depicts 40 times magnification, and the right side – 100 times. The arrows show the cut surface. There is a microscopic rupture in 33,3%, absence of hemostasis in-depth (due to the water cooling) and a very thin coagulation layer (47,9 ± 16,382 μm).

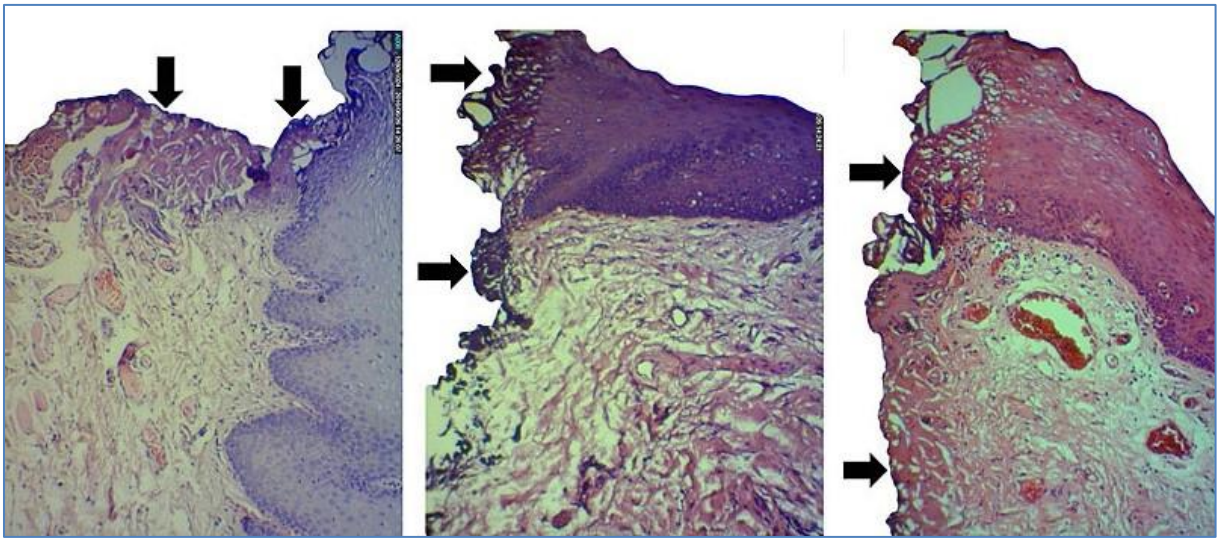

Figure 5. Histological samples of a CO_2 laser. The left side depicts 40 times magnification, and the right side – 100 times. The arrows show the cut surface. There is microscopic a rupture in 33,3%, hemostasis in depth and a very thin coagulation layer (165,11 ± 36,440 μm).

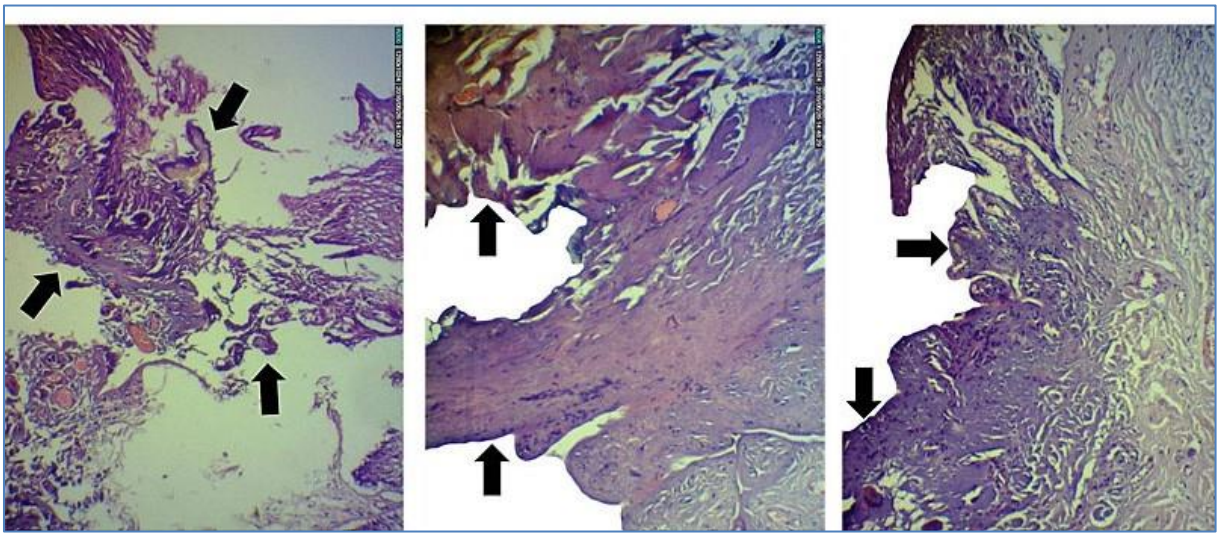

Figure 6. Histological samples of a diode laser. The left side depicts 40 times magnification, and the right side – 100 times. The arrows show the cut surface. There is a microscopic rupture, hemostasis in depth and a thick coagulation layer (948,33 ± 170,990 μm).

The best instrument of the above listed is the CO_2 laser. It provides excellent hemostasis, minimal microscopic rupture and most of all – a very thin coagulation layer (1, 10, 11, 13). Therefore the healing process is expected to be faster and with minimal side effects – pain, edema and erythema (7, 9, 12, 14, 15). The drawback is its high cost. The Er:YAG laser has a lot of advantages such as the thin coagulation layer. The main plus compared to the other instruments is the water cooling, which makes the manipulations more gentle, the reactions (pain, edema and erythema) – vague and the healing process – faster (3, 5, 7, 8, 9, 10, 12). The diode laser has a lot of advantages as well, although its results compared to the others are poor (3, 4, 6, 7, 12). The coagulation and hemostasis in-depth are well defined, which from the clinical point of view equals lack of bleeding. This allows the dentist to continue with the prosthetic procedures (such as an impression taking, cementing a restoration, etc.) in the same visit (2, 7, 9, 16). In our study women were four times more prone to having a microscopic rupture than men. The hemostasis is poorer, which is a factor the clinicians must pay attention to (10).

ACKNOWLEDGEMENT

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CONCLUSION

Lasers are increasingly becoming more popular in every field of dentistry. Knowing the advantages and disadvantages of the different kinds allows the dentist to choose the best one according to the clinical case.

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