Er:YAG Laser Debonding of Porcelain Veneers
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Removal of porcelain veneers using Er:YAG lasers has been described in case reports. The aim of this study was to systematically investigate the use of an Er:YAG laser for veneer removal without destroying the veneer as well as without aggressive destruction or removal of underlying tooth substance.

Materials and Methods: In a first step, Fourier Transform Infrared (FTIR) Spectroscopy (Nicolet™ FT-IR Spectrometer, Thermo Fisher Scientific, Waltham, Mass., USA) was used on two different, flat veneer materials (IPS Empress® Esthetic, IPS e.max Press HT, Ivoclar Vivadent, Inc, Amherst, N.Y., USA) to learn which infrared laser wavelengths are transmitted through the veneer material and how strong absorption of the veneer materials is in the infrared spectral range.

A laser energy meter (Energy Max 400, Molecotron Detector, Inc., Portland, Ore., USA) was used to determine the energy transmission dependence on veneer thickness for the Er:YAG laser wavelength (2940 nm). In addition, the FTIR characteristics and ablation thresholds of a veneer bonding cement (RelyX™ Veneer Cement shade A1, 3M ESPE, St. Paul, Minn., USA) were determined.

Next, 25 extracted anterior incisors (n = 12 for IPS Empress Esthetic, n = 13 for IPS e.max Press HT) were prepared for labial veneers placing; impressions were made, veneers were produced (2 different porcelains), thickness of the veneers were determined (Mitutoyo micrometer, Mitutoyo America, Aurora, Ill., USA), and the veneers were placed using a cement (RelyX™ Veneer Cement shade A1). An Er:YAG laser (LiteTouch™, Syneron™ Dental Lasers, Yokneam, Israel; wavelength 2940 nm, pulse repetition rate 10 Hz, pulse energy 135 mJ/pulse [laser energy measured independently at the fiber tip], free-running pulse, with a measured pulse duration of 150 µs at this energy level, 1,100-µm straight quartz fiber tip, contact mode, air spray). Three samples per veneer material were stored for 5 days in saline solution at room temperature prior to debonding. All other veneers were removed immediately after bonding. Incident Light Microscopy (Olympus B 50, MicroPublisher RTV 3.3 MP, Image Pro software, Olympus, Center Valley, Pa., USA) and Environmental Scanning Electron Microscopy (ESEM, ISI SX-40A, Topcon Instruments, Inc., Livermore, Calif., USA) were used to evaluate the interface of veneer/cement and cement/tooth structure in order to better understand the debonding process.

RESULTS
In all test samples, porcelain veneers can easily and completely be removed from the teeth with an Er:YAG laser. Moreover, underlying tooth substances can be totally preserved. The removal process is time-efficient. In the case of the IPS Empress Esthetic veneers, the majority of the veneers fractured during the removal. In contrast, all IPS e.max Press HT veneers remained intact during the laser removal process.

CONCLUSIONS
Using an Er:YAG laser to debond porcelain veneers allows the dentist to reuse the veneer in cases when a veneer initially was “misplaced.” The need of redoing the veneer can be omitted. Removal of old veneers is simplified and tooth substance is maximally preserved to place a new veneer. This presentation discusses investigational devices that have not yet received U.S. FDA approval or clearance for the specified clinical indications, or describes off-label uses.

AUTHOR BIOGRAPHY
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STUDENT SCHOLAR
Low-Level Er:YAG Laser Irradiation Enhances Osteoblast Proliferation Through Activation of MAPK/ERK

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Based on various advantageous effects, the Er:YAG laser has been recently considered as one of the most promising laser systems for periodontal and peri-implant therapy.

It has been reported in an animal study that an increased amount of new bone formation was significantly enhanced following Er:YAG laser irradiation (Mizutani K, Aoki A, Takasaki AA, Kinoshita A, Hayashi C, Oda S, Ishikawa I. Periodontal tissue healing following flap surgery using an Er:YAG laser in dogs. Lasers Surg Med 2006;38(4):314-324). One of the potential explanations for significant new bone formation might be related to the effect of low-level Er:YAG laser irradiation (low-level laser therapy, photobiomodulation).

In osteogenesis, several in vitro studies using different laser devices have previously demonstrated the positive effects of low-level irradiation in promoting new bone formation by inducing proliferation and differentiation of osteoblasts.

Since no studies have reported the effect of low-level Er:YAG irradiation on osteoblasts, the aim of this study is to investigate the potential photobiomodulatory effect of the Er:YAG laser on osteoblasts.

**MATERIALS AND METHODS**

An Er:YAG laser apparatus (VersaWave®, HOYA ConBio®, Fremont, Calif., USA) has a wavelength of 2.94 µm, an output energy range of 30 to 350 mJ/pulse, a maximum pulse repetition rate of 50 Hz, and a pulse duration of 200 µs. Laser irradiation was performed perpendicularly to the bottom of a culture dish at a distance of 15 cm. The laser energy was emitted from the handpiece without mounting a cover sleeve and contact tip in order to completely irradiate the MC3T3-E1 mouse osteoblast cells in a 35-mm tissue culture dish.

**Experiment 1**

Effect of low-level Er:YAG laser on cell proliferation

First, the laser was fixed at 30 Hz and 30 sec, and energy levels of 23 to 68 mJ/pulse (fluence: 2.1 to 6.4 J/cm²) was applied. Second, the laser was fixed at 30 Hz and 23 mJ/pulse, and irradiation time was 30-120 sec (fluence: 2.1 to 8.6 J/cm²). Third, the laser was fixed at 23 mJ/pulse and 30 sec and the pulse rate was 10 to 50 Hz (fluence: 0.7 to 3.6 J/cm²). All irradiations were performed in the absence of the culture medium. Irradiation in the presence of culture medium was also performed by applying 0.5 ml of medium, slightly covering the cell surface. The energy level was set to 23 mJ/pulse, pulse rate to 30 Hz, and irradiation time was 1 to 4 minutes (fluence: 4.3 to 17.2 J/cm²). At days 1 and 3 following Er:YAG laser irradiation, cell viability was determined by measuring the lactate dehydrogenase (LDH) levels.

**Experiment 2**

Effect of low-level Er:YAG laser on mitogen-activated protein kinase (MAPK) pathways

The involvement of MAPK pathways in laser-enhanced cell proliferation was investigated by examining the effect of specific MAPK inhibitors (added prior to irradiation) and phosphorylation of MAPKs by Western blotting. Er:YAG laser irradiation was performed at 23 mJ/pulse and 30 Hz for 60 sec (fluence: 4.3 J/cm²) in the absence of medium.

The one-way analysis of variance (ANOVA) test was used for all group comparisons, and post hoc Tukey’s test was used to compare differences between each group. A P value of < 0.05 was considered significant.
RESULTS
The low-level Er:YAG laser enhanced the proliferation of osteoblasts in an energy-, time-, and pulse-dependent manner. At various combinations of irradiation parameters, significantly increased cell proliferation was observed at fluences of approximately 1.0 to 15.1 J/cm², with no increase in LDH activity.

Regarding the effect of low-level Er:YAG laser on MAPK pathways, inhibition of laser-enhanced proliferation was observed after cell treatment with MAPK/ERK (extracellular signal-regulated kinase) inhibitor U0126. Further, Western blotting analysis revealed induction of MAPK/ERK phosphorylation 5 min following irradiation compared to nonirradiated control cells.

CONCLUSIONS
At various combinations of irradiation parameters, low-level Er:YAG laser irradiation promotes osteoblast proliferation mainly by the activation of the MAPK/ERK pathway. These findings suggest faster bone tissue healing following Er:YAG laser therapy, as well as a number of advantageous clinical therapeutic effects.

This presentation discusses investigational devices that have not yet received U.S. FDA approval or clearance for the specified clinical indications, or describes off-label uses.

AUTHOR BIOGRAPHY
Dr. Verica Aleksic has graduated as the best student of her generation from Faculty of Dentistry, University of Banjaluka, Bosnia and Herzegovina, in 2004. She joined Tokyo Medical and Dental University’s (TMDU’s) Periodontology Department for a PhD course as a winner of the Monbukagakusho Scholarship in 2005. Additionally, she is a member of Advanced International Super Students (AISS) of the Global Center of Excellence (GCOE) Program, “International Research Center for Molecular Science in Tooth and Bone Diseases,” TMDU. Dr. Aleksic is married and has one child. Dr. Aleksic may be contacted by e-mail at dr.aleksicverica@gmail.com.

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Efficacy of 640-nm Diode Laser Treatment for Prevention of Oral Mucositis in Pediatric Cancer Patients

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Oral mucositis is a morbid and costly side effect of cancer treatment in pediatric patients. No preventive or therapeutic methods have been validated for this condition. Recent evidence has shown that exposure of tissues to low-power (soft) lasers can promote wound healing in vitro and in vivo. Several studies testing the efficacy of laser for the reduction of incidence, duration, and/or severity of cancer therapy-induced oral mucositis have been performed. Results of these studies have been encouraging but most authors agree that this subject requires more clinical study. Generally, there is a paucity of studies that address preventive measures for therapy-induced mucositis in pediatric cancer patients.

Objectives of our study:
• To test the hypothesis that laser application during cytotoxic therapy will reduce incidence, severity, and duration of oropharyngeal mucositis in pediatric cancer patients.
• To study the duration of hospital stay of children treated for malignancy.

We have tested a promising and relatively novel approach to prevention of therapy-induced mucositis in children receiving cytotoxic treatment for malignant diseases. This strategy has been successful in adults and, if confirmed, may become the standard of care for oral mucositis in pediatric cancer patients. Prevention of oral mucositis and/or reduction in its signs and symptoms can significantly improve the quality of life of the patients, reduce the hospitalization costs, and, most importantly, increase the survival rate of these patients.

MATERIALS AND METHODS
We performed a prospective, randomized, double-blind study of the effect of diode He-Ne laser therapy on incidence, severity, and duration of oral mucositis in pediatric cancer patients. Eight subjects were between the ages of 3 and 18 years with a diagnosed malignancy who underwent chemotherapy at the Hematology/Oncology Department, The Children’s Hospital (TCH), Birmingham, Alabama. Laser exposure started on the first day of chemotherapy and continued each day of the cytotoxic treatment (4 to 7 days). Daily treatment lasted 15-30 minutes. We used a 640-nm diode laser (Scalar Wave Laser, Loveland, Colo., USA) with a fiber-optic and handpiece attachment for clinical application. This instrument is light and portable and can be used at the bedside. The participants were able to sit or lie in supine position while the laser procedure was performed. The participants wore protective wavelength-specific eye goggles. Sterile plastic protective sleeves were used to cover the laser handpiece. We irradiated the buccal, labial, soft palate, and floor of the mouth mucosa on half of the mouth. The side that was treated was randomly selected. Each area was irradiated for 40 seconds. The energy density was 4.5 J for each cm² of exposed tissue. This dose has been selected based on previous studies. The contralateral side received a sham treatment for the same amount of time, with the laser turned off. To reduce bias, neither the patient nor the examiners knew which side was treated. For incidence, duration, and severity of mucositis we used a student T-test for paired variables to compare OMAS (Oral Mucositis Assessment Scale) and FACES (Wong-Baker FACES Pain Rating Scale) scores from the treated vs. untreated sides of the mouth at each encounter point. Number of days of hospitalization were compared to the historical control group and were tested for correlation with mucositis scores. Subjects were matched by age, gender, type of malignancy, and chemotherapy protocol. Chi-square and Fisher’s exact tests were used for these analyses.
STUDENT SCHOLAR

RESULTS
Only 2 children developed ulcerative mucositis. However, mean oral mucositis (P = 0.27) and pain (P = 0.62) scores failed to show statistical significance between the treated and untreated sides. Similarly, total hospital days for treated children were not different from the control.

CONCLUSIONS
To our knowledge, this is one of very few studies to test laser effects for cytotoxic therapy-induced mucositis in a pediatric population. Soft laser exposure was well tolerated in pediatric cancer patients and oral mucositis incidence was very low. Larger studies are needed to support the routine use of these devices for mucositis prevention.

This presentation discusses investigational devices that have not yet received U.S. FDA approval or clearance for the specified clinical indications, or describes off-label uses.

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