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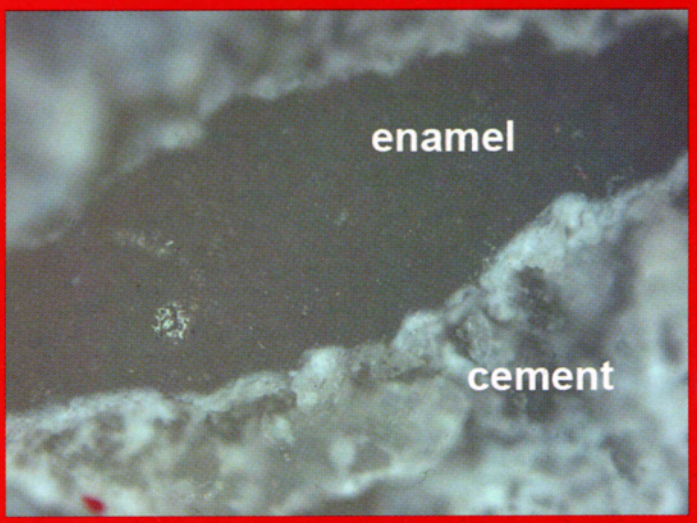
Er:YAG Laser Debonding of Porcelain Veneers

Nanoshell Assisted Laser Soldering of Vascular Tissue



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Er:YAG Laser Debonding of Porcelain Veneers

Cynthia K. Morford, DDS (CM), **Natalie C.H. Buu,** DMD (NB), **Beate M.T. Rechmann,** (BR), **Frederick C. Finzen,** DDS (FF), **Arun B. Sharma,** BDS, MS (AS), **and Peter Rechmann,** DDS, PhD (PR)*
Department of Preventive and Restorative Dental Sciences, School of Dentistry, University of California at San Francisco, 707 Parnassus Avenue, San Francisco, California 94143

Background and Objectives: The removal of porcelain veneers using Er:YAG lasers has not been previously described in the scientific literature. This study was designed to systematically investigate the efficacy of an Er:YAG laser on veneer debonding, possibly without damage to the underlying tooth, and preservation of the veneer integrity.

Study Design/Materials and Methods: The Fourier Transform Infrared Spectroscopy was used on 10 flat veneer samples (IPS Empress Esthetic, e.max Press HT) to assess which infrared laser wavelengths transmits through a veneer. Additionally, Fourier Transform Infrared (FTIR) spectra for a bonding cement (RelyX) were obtained. Consequently, Er:YAG laser energy transmission (wavelength 2,940 nm, 10 Hz repetition rate, pulse duration 100 μseconds at 133 mJ/pulse) through different veneer thicknesses was measured. Twenty-four veneers were bonded to freshly extracted and prepared incisors. The energy necessary for debonding was determined and then the veneers were debonded with the laser. Time needed for total debonding was measured and possible damage to the underlying tooth structure was assessed by light microscopy.

Results: While the veneer materials did not show any characteristic water absorption bands in the FTIR, the bonding cement showed a broad H_2O/OH absorption band. The veneers transmitted between 11.5% and 43.7% of the incident Er:YAG energy with Emax transmitting twice the energy as EE at comparable thicknesses. Initial signs of cement ablation occurred at 1.8–4.0 J/cm^2 with the fiber tip positioned at a distance of 3–6 mm from the veneer surface and 133 mJ output energy. All 24 bonded veneers were completely removed with an average removal time of 113 ± 76 seconds. Underlying tooth structure was not damaged. The debonding mainly occurred at the cement/veneer interface. None of the Emax veneers fractured during debonding, while 36% of the EE did.

Conclusion: Er:YAG laser irradiation effectively debonds porcelain veneers while preserving tooth structure. Maintaining veneer integrity possibly depends on the flexure strength of the veneer porcelain. Lasers Surg. Med. 43:965–974, 2011. © 2011 Wiley Periodicals, Inc.

Key words: Er:YAG laser; veneer debonding; porcelain veneers; FTIR; energy transmission; veneer flexure strength

INTRODUCTION

Dental veneers are very thin porcelain facings placed on front teeth to improve esthetics. They are glued on with a light-curing or self-curing resin after the tooth has undergone minimal invasive preparation, which is typically limited to enamel—the outer layer of a tooth. Veneer removal is generally performed with a rotary instrument. Using this method the veneer removal is complete, but is relatively time consuming and this technique is not ideal as the underlying tooth structure may be damaged. Since the most common reason for removal of a veneer is caries around its margins requiring an extended tooth preparation, it is obviously acceptable that the removal of the veneer is accompanied by the destruction of the veneer. Little research has been done in alternative veneer removal techniques. With the introduction of pulsed lasers into dentistry, there may be a beneficial application of such lasers for removing veneers. To the best of our knowledge, this is the first scientific publication studying laser debonding of porcelain veneers.

Short-pulsed laser ablation may be a promising method for the debonding of veneers while avoiding overheating of the pulp. If the cement is rapidly ablated, then heat conduction by the slow process of thermal softening [1–3] can be avoided [4]. The Er:YAG laser is safe for ablation of dental hard tissues [5–8] as well as composite resin [9–11]. Rising pulse repetition rate during composite removal results in a linear increase in the pulpal temperature, but still does not cause a temperature increase above the limit considered safe for the pulp vitality [10].

The objective of this laboratory study was to determine the efficacy of laser debonding of dental porcelain veneers from extracted teeth. The hypotheses were that using an Er:YAG laser: (1) allows for complete debonding of porcelain veneers from extracted teeth, (2) without damage to or removal of underlying healthy tooth structure, and (3) without destroying the veneers, in the rare occasion that

*Corresponding to: Peter Rechmann, DDS, PhD (PR), Department of Preventive and Restorative Dental Sciences, School of Dentistry, University of California at San Francisco, 707 Parnassus Avenue, San Francisco, CA 94143.
E-mail: rechmannp@dentistry.ucsf.edu
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