Laser All-Ceramic Crown Removal—A Laboratory Proof-of-Principle Study—Phase 2 Crown Debonding Time

Peter Rechmann, DDS PhD,* Natalie C.H. Buu, DMD, Beate M.T. Rechmann, and Frederick C. Finzen, DDS
School of Dentistry, Department of Preventive and Restorative Dental Sciences, University of California at San Francisco, 707 Parnassus Avenue, San Francisco, California 94143

Background and Objectives: The removal of all-ceramic crowns is a time consuming procedure in the dental office. Little research has been done in alternative removal techniques for all-ceramic crowns. The objective of the second phase of this proof-of-principle laboratory pilot study was to evaluate whether Ivoclar Vivadent all-ceramic crowns can be efficiently removed from natural teeth without damage to the underlying tooth structure using an Erbium laser.

Study Design/Materials and Methods: The ceramic materials used were IPS E.max CAD Lithium-disilicate (LS_2) (E.max CAD) and IPS E.max ZirCAD Zirconium-oxide (ZrO_2) (ZirCAD) (Ivoclar, Vivadent, Liechtenstein). Molars, either as stand-alone teeth or placed in an artificial row of teeth, were prepared to receive all-ceramic crowns. Copings and full contour crowns with either featheredge or regular margins were produced. The all-ceramic crowns were bonded to the teeth with Ivoclar Multilink Automix. The time for Er:YAG laser debonding of each crown was then measured. The Er:YAG (LiteTouch, Syneron, Yokneam, Israel) was used with an 1,100 μm diameter fiber tip with energies up to 600 mJ per pulse (wavelength 2,940 nm, 10 Hz repetition rate, pulse duration 100 μs at 126 mJ/pulse, and 400 μs at 590 mJ/pulse). The irradiation was applied at a distance of 10 mm from the crown surface following a defined pattern. Air-water spray was applied to the crowns at a rate of 67 ml/minute.

Results: All of the all-ceramic crowns were successfully debonded with the laser. On average, an all-ceramic E.max CAD crown was debonded in 190 ± 92 seconds (average ± SD). The debonding time for ZirCAD featheredge crowns was 226 ± 105 seconds and for ZirCAD crowns with regular margins it was 312 ± 102 seconds. No crowns fractured and no damage to the underlying dentin was detected. The bonding cement deteriorated due to the Er:YAG irradiation. Additionally, no carbonization at the dentin/cement interface was observed.

Conclusion: Er:YAG laser energy can successfully be used to efficiently debond all-ceramic full contour crowns from natural teeth without damage to the underlying tooth structure. Lasers Surg. Med.

Key words: all-ceramic crowns; Er:YAG laser; laser debonding; crown removal; debonding time; zirconium-oxide; lithium-disilicate

INTRODUCTION

Dental crowns are indicated when tooth structure has been weakened due to caries, large fillings, fractures or root canal treatments. Porcelain fused to metal (PFM) crowns in which porcelain is layered on top of a metallic alloy still dominate the tooth-colored restoration market.

Nevertheless, in the last few decades tremendous advances in the physical properties and methods of fabrication of ceramic materials have led to the increasing use of all-ceramic tooth colored crowns [1]. In addition, advances in bonding techniques which allows gluing the all-ceramic crown to the tooth, have also increased the utilization of all-ceramics in dentistry [2,3]. The increasing demand for esthetic, tooth-colored restorations has resulted in an increased use of dental ceramics for both visible anterior crowns as well as posterior teeth [4,5]. Using all-ceramic crowns for posterior teeth requires materials, which can withstand high occlusal forces. Newer ceramic materials such as Lithium-disilicate (LS_2) and especially Zirconium-oxide (ZrO_2), which has the highest fracture resistance amongst ceramics, have made all-ceramic crowns a practical alternative to PFM crowns [1,2,6].

Recent advances using anatomically shaped CAD/CAM fabricated monolithic crowns without additional porcelain veneering can fulfill esthetic as well as functional requirements. Monolithic crowns do not experience chipping of the veneering porcelain. Additionally, other failures such as fatigue failures can often be prevented [3,5,7–9]. Consequently, these systems are considered as potential replacements for metal-ceramic restorations [3].

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