THE JOURNAL OF PROSTHETIC DENTISTRY

CLINICAL REPORT

# Laser-assisted debonding of lithium disilicate veneers using an erbium chromium yttrium scandium gallium garnet laser: A clinical report

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## ABSTRACT

Ceramic veneers have been widely used as minimally invasive esthetic restorations; however, removal of bonded veneers can be challenging because conventional mechanical techniques may compromise tooth structure. Erbium lasers have been proposed as a conservative alternative because of their selective interaction with resin cements. This clinical report describes laser-assisted debonding of lithium disilicate veneers using an erbium chromium yttrium scandium gallium garnet (Er,Cr:YSGG) laser. A 22-year-old woman presented for replacement of 6 maxillary lithium disilicate veneers. Debonding was performed using an Er,Cr:YSGG laser (wavelength of 2780 nm) at 5 W power, 15 Hz frequency, and 60 µs pulse duration, with 40% water and 60% air in noncontact mode. The veneers were removed with minimal mechanical force, within clinically acceptable debonding times. No pulpal sensitivity, enamel damage, or ceramic fracture was observed. (J Prosthet Dent xxxx;xxx:xxx-xxx)

Ceramic veneers are commonly used esthetic restorations that rely on adhesive protocols, enabling conservative tooth preparation.[1] Historically, feldspathic porcelain was the material of choice; however, contemporary ceramics such as lithium disilicate allow reduced restoration thickness while maintaining favorable mechanical properties and long-term durability.[2] Although ceramic laminate veneers demonstrate high survival rates, complications may occur that require veneer replacement, including incisal edge chipping, marginal discoloration, or gingival recession exposing the veneer–tooth interface.[3,4] Secondary caries and endodontic complications occur less frequently because of the favorable margin placement.[5] The removal of bonded ceramic veneers presents a clinical challenge because the restoration integrates seamlessly with the underlying tooth structure. Conventional removal techniques rely on rotary instrumentation, which is time-consuming and technique-sensitive and may risk unnecessary removal of sound tooth structure.[3,4]

Erbium-based lasers, including erbium-doped yttrium aluminum garnet (Er:YAG) and erbium chromium yttrium scandium gallium garnet (Er,Cr:YSGG), have been widely used in dentistry because of their high absorption in water.[6,7] Ceramic materials permit partial transmission of laser energy, allowing interaction with the underlying resin cement,[8,9] enabling selective ablation of the cement layer and leading to the development of laser-assisted debonding techniques.[8,10]

The effectiveness of erbium lasers in debonding ceramic restorations and orthodontic attachments has been evaluated, with favorable outcomes in terms of efficiency and the preservation of tooth structure.[11–14] Systematic reviews and clinical analyses have further supported the clinical feasibility of this approach when appropriate parameters are used.[5,15]

Despite promising results, a consensus regarding optimal laser parameters that ensure efficient debonding without compromising ceramic integrity or inducing excessive pulpal temperature rise is lacking. Three

The authors declare no conflict of intrest.

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## Clinical Implications

Provide safe and predictable technique for veneers debonding.

studies have identified parameter ranges within which intrapulpal temperature remains below the critical threshold of 5.5 °C.[5,16,17] Additionally, variables such as power output, pulse duration, and cooling conditions have been shown to influence both efficiency and safety.[18–21]

Although laser-assisted debonding has been described, detailed clinical protocols for Er,Cr:YSGG-assisted removal of lithium disilicate veneers remain limited. The purpose of this clinical report was to describe a step-by-step clinical workflow using optimized laser parameters to achieve efficient and conservative veneer removal.

## CLINICAL REPORT

A 22-year-old woman presented seeking the replacement of ceramic veneers (Fig. 1) placed 2 years earlier. Intraoral examination revealed 6 lithium disilicate veneers extending from canine to canine that appeared darker than the adjacent natural teeth and unnaturally wide because of


**Figure 1.** Preoperative situation. A, Full face smiling. B, Maxillary arch showing defective veneers.

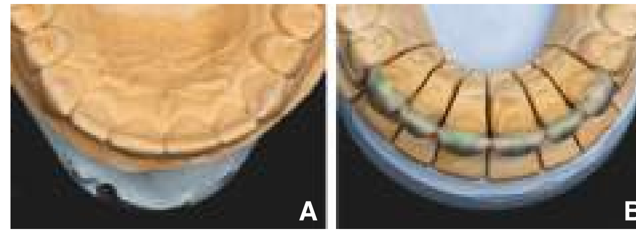


**Figure 2.** Effect of facial line angles on perceived tooth width. A, Excessively wide facial line angles create wide tooth appearance. B, Moving line angles inward produced visual illusion of narrower tooth.

inappropriate facial line-angle placement (Fig. 2A). Periodontal assessment revealed healthy tissues with no bleeding on probing. All veneers were intact, with no visible cracks or fractures. The patient demonstrated a stable occlusion with no clinical evidence of parafunctional activity. Periapical and panoramic radiographic examinations revealed no signs of periodontal or periapical pathology and confirmed stable bone levels.

Following digital smile design and diagnostic waxing, replacement restorations were planned to address the perceived width by modifying the facial line-angle positions (Fig. 2B) and localized characterization to create a narrower visual appearance without altering the tooth dimensions (Fig. 3). Laser-assisted removal was then planned using an Er,Cr:YSGG laser (wavelength 2780 nm) (Waterlase iPlus system (Biolase). The procedure was performed with a gold handpiece equipped with an MZ4 tip, operated at 5 W power, 15 Hz frequency, and 60 µs pulse duration, using 40% water and 60% air. These parameters were selected based on previously published in vitro studies, available clinical reports, and the objective of balancing debonding efficiency with thermal safety.[18–21] Laser irradiation was delivered in noncontact mode at a working distance of approximately 2 to 3 mm by using continuous vertical and horizontal scanning motions at an estimated speed of 2 mm/second (Fig. 4). After complete surface scanning, veneers were gently mobilized using an explorer inserted at the cervical margin. When necessary, additional laser irradiation was applied to facilitate debonding. The time required for veneer removal ranged from 2 to 5 minutes, with a mean debonding time of approximately 2.5 minutes per veneer.

**Figure 3.** Narrower visual appearance without altering tooth dimensions.

Figure 4. Laser protocol in noncontact mode using gold handpiece.

Following removal, the underlying tooth structure exhibited no signs of carbonization or mechanical damage. The patient reported no symptoms of pulpitis during or after the procedure. Examination of the debonded veneers revealed localized areas of cement charring without structural compromise of the ceramic.

Subsequently, residual cement remnants were removed using airborne-particle abrasion with 50-µm aluminum oxide particles (RONDOflex plus 360, KaVo) for surface abrasion, and the tooth preparations were then refined. A displacement cord (Ultrapak Retraction Cord, Ultradent Products, Inc) was placed to finalize the finish lines (light chamfer) and obtain a definitive impression, after which interim veneers were fabricated (Visalys Temp A1). The patient reported no postoperative sensitivity during the interim restoration phase. Definitive lithium disilicate veneers were cemented under dental dam isolation, in pairs, beginning with the maxillary central incisors (Fig. 5). At the postoperative evaluation, the patient expressed satisfaction with the esthetic outcome of the definitive restorations (Fig. 6). The improvement in smile esthetics is illustrated in the preoperative and postoperative smile views (Fig. 7). At the 2-year follow-up, the restoration remained stable without marginal


Figure 6. Postoperative situation. A, Full face smiling. B, Maxillary arch.

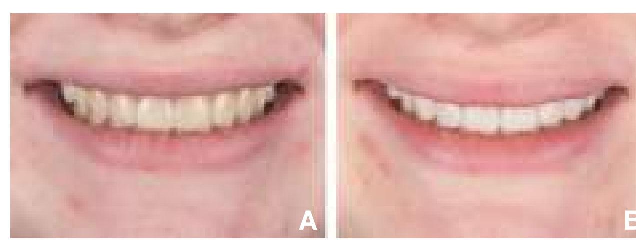


Figure 7. Smile views. A, Preoperative. B, Postoperative.

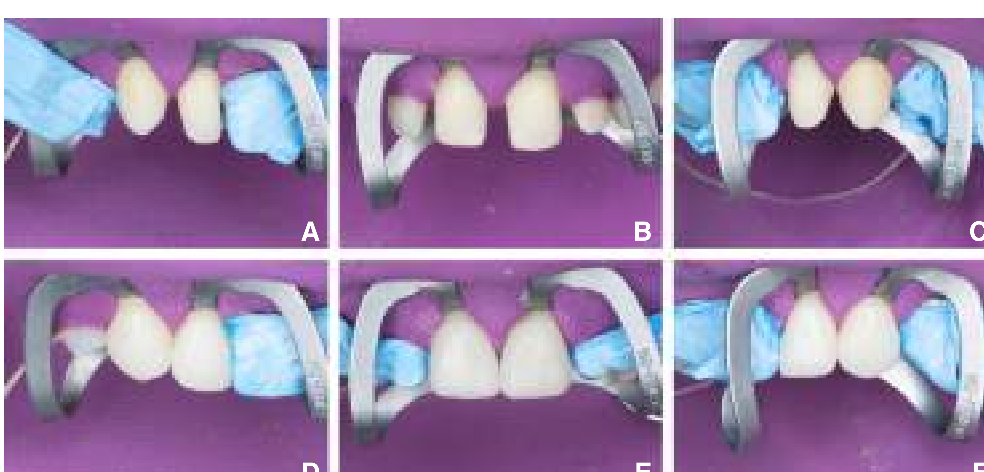


Figure 5. Cementation under dental dam isolation. A, Prepared right canine and lateral incisor. B, Prepared central incisors. C, Prepared left canine and lateral incisor. D, Seated right canine and lateral veneers. E, Seated central incisors veneers. F, Seated left canine and lateral veneers.

discoloration, and the teeth remained vital with no signs of pulpal alteration.

## DISCUSSION

The use of erbium-family lasers for ceramic debonding has been previously investigated in orthodontics and restorative dentistry, with favorable outcomes reported in both experimental and clinical studies.[11,14] These lasers operate at infrared wavelengths characterized by high absorption in water, enabling efficient interaction with the resin cement layer beneath ceramic restorations.[7,9]

Laser energy penetrates ceramic materials and interacts with water molecules within the resin cement, resulting in rapid vaporization and micro-explosive ablation. Because resin cement contains higher water content than ceramic and dental tissues, it is preferentially affected by laser irradiation.[9]

Several factors influence the efficiency and safety of laser-assisted debonding, including ceramic composition and thickness.[10,12,13] Lithium disilicate ceramics exhibit higher translucency compared with zirconia, allowing greater laser energy transmission and more predictable cement ablation.[21] Previous studies have reported shorter debonding times for lithium disilicate restorations, whereas zirconia may require longer irradiation times.[4,5]

Differences between erbium laser systems should also be considered. Er:YAG lasers exhibit higher absorption in water compared with Er,Cr:YSGG systems, potentially resulting in more aggressive ablation.[5,22] However, previous investigations have shown comparable clinical effectiveness between systems under appropriate parameters.[23,24]

Laser parameters play a critical role in balancing efficiency and safety. Power output, pulse duration, and cooling conditions influence both ablation rate and thermal effects.[18–21] In the present case, the use of 5 W power and short pulse duration (60 μs) allowed efficient debonding without evidence of ceramic damage or pulpal irritation. Short pulse durations promote efficient ablation while limiting thermal diffusion.[20]

Water and air spray are essential for thermal control. Adequate cooling prevents excessive temperature rise while maintaining ablation efficiency. Previous studies have demonstrated that erbium lasers can be used safely when appropriate cooling and scanning strategies are applied, maintaining intrapulpal temperature below the critical threshold.[5,17]

The noncontact technique and continuous scanning motion used in this report contributed to uniform energy distribution and minimized localized heat accumulation. These findings are consistent with previous recommendations emphasizing dynamic irradiation to enhance safety.[20,24]

The mean debonding time of approximately 2.5 minutes per veneer falls within the clinically acceptable range reported in the literature.[10,15] No adverse effects, including pulpal sensitivity or structural damage, were observed, supporting the clinical viability of this approach.

Compared with conventional mechanical techniques, laser-assisted debonding offers a more conservative alternative with reduced risk of enamel damage and restoration fracture. However, limitations include the need for specialized equipment, operator training, and the absence of standardized clinical protocols. Clinical studies are required to establish evidence-based guidelines for optimal laser parameters and to evaluate long-term outcomes.

## SUMMARY

This clinical report describes the laser-assisted debonding of lithium disilicate veneers using an Er,Cr:YSGG laser. For this patient, the selected laser parameters allowed conservative veneer removal without apparent damage to tooth structure or ceramic restorations and without postoperative sensitivity. Debonding times were consistent with those reported in the literature. Clinical investigations are required to validate standardized protocols and to assess pulpal safety and long-term outcomes.

## PATIENT CONSENT

Written informed consent was obtained from the patient prior to participation, including consent for clinical evaluation, data collection, and publication of de-identified information and any accompanying images.

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https://doi.org/10.1016/j.prosdent.2026.05.040