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Laser Ceramic Veneer Debonding Reasons &Methods: Narrative Review

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Abstract

Ceramic laminate veneers are widely recognized in aesthetic dentistry for their lifelike appearance, favorable mechanical behavior, and the ability to improve a patient's smile with minimal removal of tooth structure. Their reliable bonding protocols and long-term clinical performance have made them a preferred option for many restorative and cosmetic treatments. Nevertheless, situations such as functional failure, esthetic concerns, chipping, secondary caries, or the need for design modifications may require the removal of an existing veneer. Detaching a bonded veneer, however, is often difficult when using traditional rotary instruments. The strong adhesion between the ceramic, resin cement, and enamel can make controlled removal challenging, increasing the risk of overheating, excessive enamel loss, and accidental damage to surrounding tissues. In response to these limitations, laser-assisted debonding has gained attention as a more conservative and predictable method for veneer removal. Specific laser wavelengths—especially those in the erbium family—can interact with the underlying resin cement by promoting thermal softening or micro-ablation without significantly affecting the ceramic structure or the tooth itself. This selective interaction weakens the adhesive interface, allowing veneers to be detached with less force and greater precision. Clinical studies have shown that laser-assisted techniques can shorten treatment time, enhance patient comfort, and substantially reduce the likelihood of enamel damage compared with mechanical removal. This narrative review discusses the development of laser technologies relevant to veneer debonding, the scientific principles behind laser interactions with dental materials and tissues, and the available clinical evidence supporting their use in modern restorative practice.

Keywords: Laser-assisted debonding; ceramic laminate veneers; Er:YAG laser; Er,Cr:YSGG laser; resin cement ablation; veneer removal techniques; adhesive interface failure

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1. Introduction

Smiling is one of the main aspects of facial aesthetics, and many studies have proved that an attractive smile can have a positive impact on a person's well-being [1-4]. With increased awareness about the criteria of a healthier smile and the rise of the hype of what so called "Hollywood smile" on several social media platforms, this led to adoption of elective cosmetic dental treatments [5-6]. As a result, modern dentistry has evolved beyond treating oral diseases, emergencies, and restoring carious teeth [7-8]. Among elective treatments, laminate veneers have become a highly demanded option [9-11]. However, it is recommended that dentists follow a more conservative approach to cosmetic dental procedures, allowing for possible retreatment if necessary [12-13]. Since their introduction in 1983, porcelain veneers have been considered one of the most conservative treatment options in aesthetic dentistry due to their excellent strength, longevity, biocompatibility, and superior aesthetics [14]. The continuous advancements in adhesive technologies have significantly contributed to their popularity by enabling minimally invasive approaches that conserve healthy tooth structure and improve clinical functionality [15]. The combination of these favorable criteria increased the indications for ceramic restorations.

These include single-tooth crowns, partial crowns, laminate veneers, inlays, on lays, and implant-supported prostheses [16-18]. Furthermore, according to manufacturers' guidelines, lithium disilicate (LS2) ceramics are suitable for fabricating short-span fixed partial dentures (FPDs) extending up to the first premolar [19]. These materials are commonly processed using CAD/CAM systems and have demonstrated excellent outcomes in terms of strength and esthetic integration, making them among the most widely accepted treatment options in clinical practice (e.g., CEREC Tessera, Dentsply Sirona, Charlotte, USA; IPS Emax CAD, Ivo Clar Vivadent, Schaan, Liechtenstein) [20-21]. Due to their relatively increased glass content, LS2 ceramics are bonded adhesively following a specific adhesive protocol including surface treatment with hydrofluoric acid and silane application. Their flexural strength—often exceeding 350 MPa—permits conservative preparation designs that preserve most of the enamel, enhancing the success of adhesive bonding protocols [22]. The color and optical properties of dental ceramics are crucial in ensuring

patient satisfaction and achieving esthetically pleasing outcomes. As improvements in the mechanical performance of ceramic materials continue, both clinical and research efforts have increasingly focused on enhancing their visual similarity to natural dentition [23].

IPS™ Emax CAD addresses this demand through a broad selection of shades and translucency levels, which allow for significant adaptability in clinical applications [23-24]. Despite high success rates, laminate veneer failure may occasionally necessitate removal. Due to issues such as misfit during cementation with improper marginal seating, pulpal symptoms, or chipping shortly after usage. Given the strong adhesive interface between ceramic and enamel, removal poses a significant clinical challenge. Conventional removal using rotary instruments involves sectioning or grinding through the veneer. This creates a risk of damaging the underlying tooth structure, due to minimal contrast between ceramic, resin cement, and enamel [25]. Moreover, when early removal is required to correct placement or discomfort, preserving the integrity of the veneer is sometimes critical to avoid remaking the restoration with a risk of mismatching Unfortunately, traditional mechanical removal makes it almost impossible for veneers to be removed intact. To overcome these difficulties, the use of lasers was recently introduced as a more comfortable and more conservative restoration removal technique [25].

2. Clinical Indications for Ceramic Veneer Replacement

Ceramic veneer replacement is typically indicated due to esthetic, structural, biological, or functional concerns, see figure1.

1) Esthetic Concerns

- Color mismatch or staining: Veneers may discolor over time or no longer match adjacent teeth due to aging or dietary habits.
- Shape or contour dissatisfaction: Patients may seek improved symmetry, tooth length, or smile design, especially with evolving esthetic expectations.
- Gingival recession: Exposed margins compromise esthetics and may necessitate veneer redesign.

2) Structural Failures

- Fracture or chipping: Often caused by trauma, bruxism, or occlusal overload, particularly in feldspathic ceramics.
- Debonding: Loss of adhesion due to aging cement, poor bonding technique, or material incompatibility is a frequent cause of failure.
- Marginal defects: Gaps or microleakage at veneer margins can lead to secondary caries or hypersensitivity.

3) Biological Factors

- Caries under the veneer: Often due to poor oral hygiene or marginal leakage, requiring removal and retreatment.
- Periodontal issues: Inflammation or recession may necessitate removal and redesign of the veneer.
- Pulpal pathology: If endodontic treatment is needed, veneer removal is often required to access the pulp chamber.

4) Material Aging or Incompatibility

- Surface wear or glaze loss: Leads to roughness, plaque accumulation, and esthetic decline over time.
- Outdated materials: Older feldspathic veneers may be replaced with stronger lithium disilicate or zirconia ceramics for improved longevity.

5) Functional Adjustments

- Occlusal rehabilitation: Full-mouth reconstructions or bite changes may require veneer replacement to harmonize occlusion.
- Orthodontic treatment: Post-treatment alignment changes can affect veneer fit and esthetics, prompting replacement [28-29].

Ceramic veneer removal can be approached either as intact removal (preserving the veneer) or fragmented removal (when the veneer is fractured or must be sacrificed) as shown in Figure 2. The technique depends on the clinical situation, material type, and reason for replacement.

3. Intact Removal of Ceramic Veneers

❖ *Indications*

- Veneer is esthetically or functionally unsatisfactory but structurally intact.
- Rebonding or reuse is planned (rare but possible).
- Diagnostic or trial removal is needed before the final decision.

❖ *Techniques*

- Ultrasonic scalers: Used to disrupt the resin cement interface without damaging the veneer.
- Laser-assisted removal: Er:YAG or Er,Cr:YSGG lasers can soften resin cement selectively, allowing atraumatic debonding.
- Fine diamond burs: Used cautiously to access margins without fracturing the veneer.

❖ *Considerations*

- Risk of damaging enamel or veneer during removal.
- Time-consuming and technique sensitive.
- Best suited for lithium disilicate veneers due to their strength and translucency.

4. Broken or Fragmented Removal

❖ *Indications*

- Veneer is fractured, chipped, or debonded beyond repair.
- Secondary caries, pulpal pathology, or structural failure present.
- Veneer material is outdated or incompatible with new treatment.

❖ *Techniques*

- Sectioning with diamond burs: Veneer is cut into segments to facilitate removal.
- Controlled fracture: Applying force to break the veneer intentionally for easier access.
- Adhesive grinding: Removing residual resin cement from enamel using polishing discs or carbide burs.

❖ *Considerations*

- Higher risk of enamel loss or pulpal irritation.

- Requires careful planning to avoid damaging underlying tooth structure. Often followed by new preparation and bonding protocol [30-31].

5. Laser-Assisted Debonding: A Minimally Invasive Solution

To overcome these limitations, laser-assisted veneer debonding has emerged as a conservative, patient-friendly alternative. Initially developed for the debonding of ceramic orthodontic brackets, this technique uses targeted laser energy to soften or thermally degrade the resin cement, allowing for veneer removal with minimal trauma to the tooth and restoration [25–27]. Studies have shown that this method not only preserves the structural integrity of the veneer but also reduces patient discomfort, potentially enabling reuse or repositioning of restoration in select clinical scenarios [32]. As method gains a wider audience, laser-assisted debonding may become tool of choice for managing restoration failure or adjustment without sacrificing the restorative material.

6. The Evolution and Fundamentals of LASER Technology

6.1. A Historical Overview

The development of laser technology is deeply rooted in the evolution of electromagnetic theory and quantum physics. Between 1861 and 1864, James Clerk Maxwell formulated the theory of electromagnetic waves, establishing that light propagates as a wave through space—an idea that remained dominant until the early 20th century [33]. In 1900, Philip Lenard observed that the emission of electrons from certain materials was dependent not on the intensity but on the frequency of incident light. This finding suggested that light exhibits both wave-like and particle-like behavior, a concept foundational to quantum theory. Building upon this, Max Planck introduced the concept of quantized energy emission with the equation E = hf, where E is photon energy, h is Planck's constant, and f is the frequency of light [34]. The Albert Einstein expanded Planck's work in 1905 by proposing the theory of the photoelectric effect, introducing the mechanisms of spontaneous and stimulated emission—phenomena that would later become central to the laser operation [35]. The first step toward a practical laser device came in 1953, when Charles Townes and colleagues developed the MASER (Microwave Amplification by Stimulated Emission of Radiation). This technology was later extended into the optical spectrum by Townes and the Arthur Schawlow in 1958.

Finally, in 1960, Theodore Maiman developed the first functional laser using a ruby crystal as the active medium, energized by a flashlamp—marking the birth of LASER (Light Amplification by Stimulated Emission of Radiation) technology [36]. Dental applications of lasers began to emerge shortly after. In 1965, Dr. Leon Goldman dermatologist who had been experimenting with tattoo removal directed a ruby laser at a tooth and observed enamel surface modifications without inducing pain—an early demonstration of the potential for lasers in dentistry [37-38]. Over the following decades, the development of CO_2 and Nd:YAG (Neodymium Yttrium Aluminium Garnet) lasers enabled deeper and more controlled interaction with both hard and soft dental tissues. In 1990, the U.S. Food and Drug Administration (FDA) approved the first pulsed Nd:YAG laser for intraoral soft tissue surgery [39-40]. Since then, a wide range of wavelengths—including Argon, Er:YAG, Er,Cr:YSGG, and Ho:YAG lasers—has been introduced for various clinical applications in the dental practice [41-42].

6.2. Laser Wavelengths and the Electromagnetic Spectrum in Dentistry

Lasers function across specific segments of the electromagnetic spectrum, and their biological effects are determined by their wavelength, which dictates how laser energy interacts with various tissues [43]. The key spectral regions relevant to dental applications include:

Ultraviolet (UV): Excimer lasers, though rare in dentistry, are used in ophthalmology due to their precision in surface ablation.

Visible Light (400–700 nm): Includes Argon lasers (488 and 514 nm) and Helium-Neon (HeNe) lasers (632.8 nm), often used in diagnostic imaging & low-level laser therapy (LLLT).

Near-Infrared (700–1100 nm): Diode lasers (810–980 nm) dominate in dentistry for soft tissue surgery, hemostasis, and caries detection.

Mid-Infrared (2780–2940 nm): Er:YAG(2940nm) and Er,Cr:YSGG lasers(2780nm) exhibit strong absorption by water and hydroxyapatite, making them ideal for hard tissue ablation as well as soft tissue procedures. They are highly absorbed in Water and OH -molecules, they operate well on hard tissues like bone, cartilage, enamel, dentine, caries as well as soft tissue surgery.

Far-Infrared (9000–10,600 nm): CO_2 lasers, characterized by high water absorption, are predominantly used for soft tissue surgeries due to their precise cutting and excellent coagulation [42].

LASER light is the light wave produced by a specific form of electromagnetic energy that behaves as a particle and a wave. The basic unit of energy is called a photon. The wave of photons produced by a LASER can be defined by 3 measurements, namely, Velocity (speed of light), Amplitude (intensity in the wave) which is the total height of the wave oscillation from the top of the peak to the bottom of the vertical axis and Wave length which is the distance between any two corresponding points on the wave on the horizontal axis. The larger the amplitude, the greater the performable work [38]. LASER light occurs through the amplification of stimulated emissions. Amplification is part of a process that occurs inside the LASER. Identifying the components of a LASER instrument is useful in understanding how light is produced [41].

6.3. Unique Properties of Laser Light

Laser light differs fundamentally from ordinary light in three critical ways:

Monochromatic: Laser light is composed of a single wavelength, allowing for targeted interaction with specific tissue components (e.g., water or hydroxyapatite).

Coherent: All photons in the beam are phase-synchronized in time and space, enabling more focused energy delivery.

Collimated: The laser beam is highly parallel, minimizing divergence and allowing for precision in clinical application [38-39-42]. These characteristics make lasers highly effective and predictable in dental procedures, from conservative cavity preparation to periodontal surgery and minimally invasive veneer debonding.

6.4. Components of a Laser System

A functional laser system consists of three essential components as demonstrated in figure 3: Active Medium — LASERs are named after their active medium. Each active medium is responsible for the LASER wavelength since each atom is energy specific in transition between energy levels for the active medium to work, we must ensure that enough electrons are in a specific higher energy level for stimulated emission to occur. To Ensure that electrons are in the exact excited state we need to excite the active medium the solid-state materials can be used as an active medium, the core material responsible for light generation, whose composition dictates the laser's wavelength. For example, Theodore Maiman's ruby laser used aluminum oxide (Al_2O_3) doped with chromium ions (Cr^{3+}). Other common laser media include Nd:YAG, Er:YAG, and Er,Cr:YSGG, which are metallic ions embedded into a transparent matrix via doping, these are artificially made as they arent found in nature. Pump Source — a device that excites electrons in the active medium by a process called "pumping" using energy from a flash lamp (e.g., Er:YAG lasers), electrical current (diode lasers), or gas discharge.A variety of pump sources are present such as Flash Lamps, Electric Current and Gas. Diode LASERs are pumped by electric current since its active medium is a semiconductor and finally Gas discharge used in LASERs where the active medium is composed of Gas ions. Crystal based LASERs are pumped by flash Lamps ex: (Er:YAG and Er;Cr:YSGG).

Resonator: A Resonator is mandatory for producing a LASER beam. formed by two mirrors at either end of the active medium: one fully reflective, the other partially transmissive to allow beam escape. Photons resonate between the mirrors, stimulating more emissions, and amplifying the beam [45]. A virtual line is connecting between the center of the two mirrors and the crystal; this line is called the Laser axis. The number of photons keeps bottling up if there is continuous excitation of the active medium. Once energized, the excited electrons emit photons that induce additional stimulated emissions—creating a cascade. The resonator aligns and intensifies these photons, resulting in a coherent, collimated beam suitable for clinical applications [38].

6.4. Laser–Tissue Interactions

When laser light encounters biological tissue, one of four interactions occurs see figure 4:

Reflection — some light bounces off the tissue, without energy transfer.

Transmission — light passes through tissues with minimal absorption or effect.

Scattering — the beam direction is altered, diminishing precision without energy loss.

Absorption — critical for dental use; energy is taken up by tissue, resulting in cutting, vaporization, or therapeutic effects [38-47].

7. Laser-Assisted Debonding of Ceramic Restorations

7.1. Mechanisms of Debonding

L.J. Tocchio, S.R. Habib, and W.D. Baughman categorized three modes by which laser energy weakens adhesive bond as shown in Figure 5:

Thermal Softening — gradual heating softens resin, allowing manual removal.

Thermal Ablation — rapid vaporization of resin, achieving quicker debonding with less heat conduction.

Photoablation — high-intensity pulses break molecular bonds, enabling minimal thermal rise and precise removal.

Thermal ablation and photoablation are generally preferred due to more controlled and efficient outcomes [49]. because they proceed so rapidly thus the temperature of resin and tooth surface remains in the same physiologic range.

7.2. Preferred Lasers for Ceramic Debonding

Erbium-based lasers such as Er:YAG (2940 nm) and Er,Cr:YSGG (2780 nm) are particularly effective for resin–ceramic debonding because their wavelengths are strongly absorbed by resin and water-based adhesives. These systems often achieve faster, safer removal than CO_2 or Nd:YAG lasers [49-50]. However, in addition to the laser type, laser bonding procedure is highly affected by the ceramic type as well. It was reported that monocrystalline ceramic brackets are more suitable for laser debonding than polycrystalline ceramic brackets.

- ***In Vitro Evidence: Effect of Veneer Thickness and ARI***

A Brazilian in vitro study by S.I. Al-Araji, and A.R. Sulaiman demonstrated that Er,Cr:YSGG irradiation reduced shear bond strength from ~10.9 MPa to ~3.8 MPa for 0.5 mm veneers, and from ~14.7 MPa to ~5.0 MPa for 1 mm veneers ($p < 0.001$), with no significant effect of ceramic thickness on bond strength reduction. Higher Adhesive Remnant Index (ARI) scores in the laser groups suggested most cement remained on the tooth, minimizing enamel damage [46]. Similarly, studies on ceramic orthodontic bracket removal with Er:YAG lasers showed reduced bond strength and higher ARI scores, without enamel cracks or excessive intrapulpal temperature rise (mean <1–3°C). This suggests that laser softens or ablates resin effectively while preserving tooth integrity [47]. Monocrystalline ceramics were observed to respond better to laser debonding than polycrystalline types, likely due to differences in structure and light transmission [50]. C.K. Morford, N.C. Buu, B.M. Rechmann, F.C. Finzen, A.B. Sharma, P. Rechmann conducted a study using two materials for the veneers IPS Empress Esthetic (EE) (leucite glass-ceramic) and IPS e.max Press HT (Emax) (lithium disilicate glass-ceramic bonded to Freshly extracted Centrals [25]. Er:YAG was used to debond veneers with following parameters: 133 mJ/pulse, 10 Hz, 3–6 mm distance of the fiber tip to the veneer applying air spray; simple irradiation pattern was used.

First, all margins of the veneer were irradiated, avoiding the thinnest cervical areas. This was followed by a horizontal parallel ‘‘laser-painting’’ of the veneer sur- face, starting from the incisal edge down to the cervical margins. The removal time for a veneer ranged from 31 to 290 seconds. The Emax veneers were removed slightly faster than the EE veneers but the difference in removal time was not significant (P ¼ 0.6; unpaired t-test). Light microscopy revealed no damage to the tooth due to the laser debonding of veneer. The light microscopical pictures showed that debonding occurred mainly at veneer/cement interface. In a research by Tak, O.; Sari, T.; Malkoc, M. A.; Altintas, S.; Usumez, A.; and Gutknecht, N., directed to study effect of Laser irradiation on different type of cements, G-Cem LinkAce, Multilink Automix, Variolink II, Panavia F, and Rely X Unicem U100.

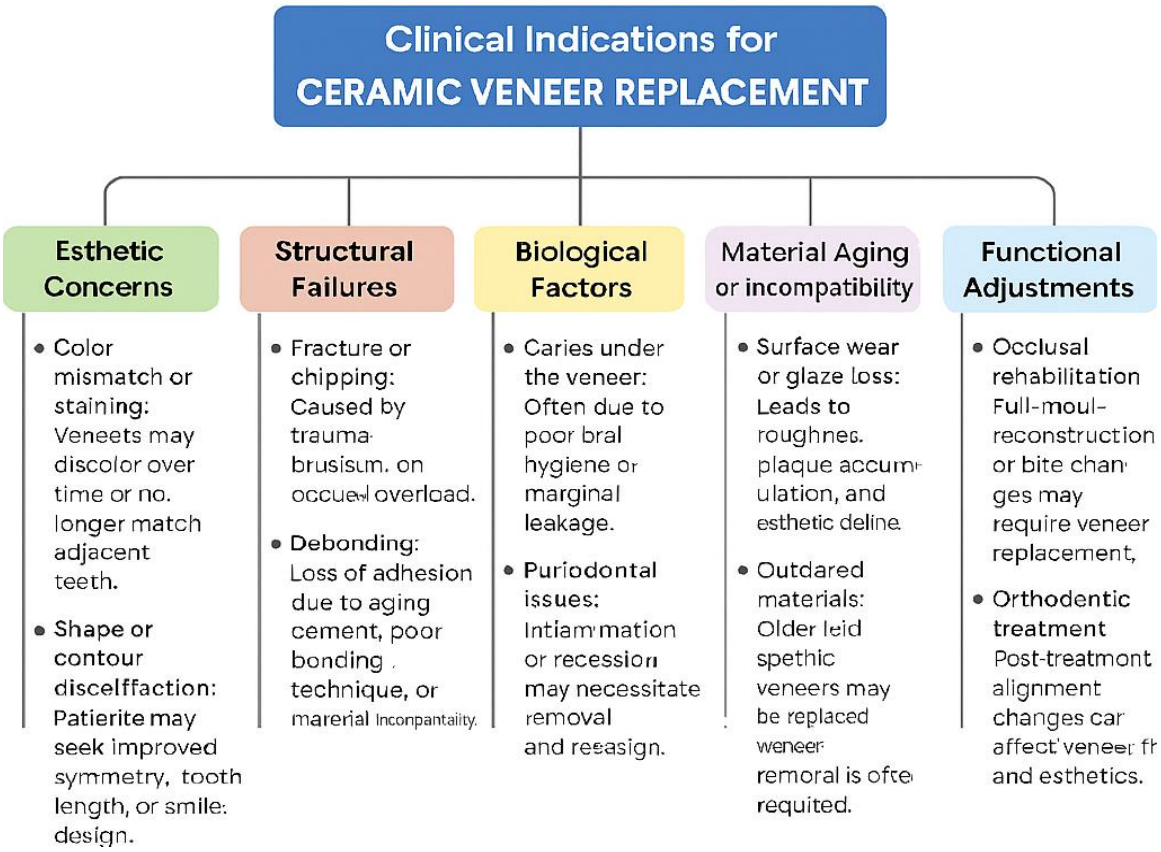

Figure 1: clinical indications for ceramic veneer replacement.

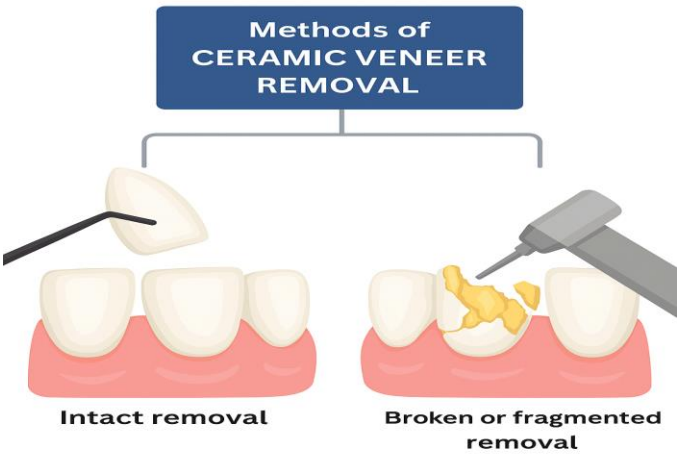

Figure 2: Demonstrating methods of veneer removal.

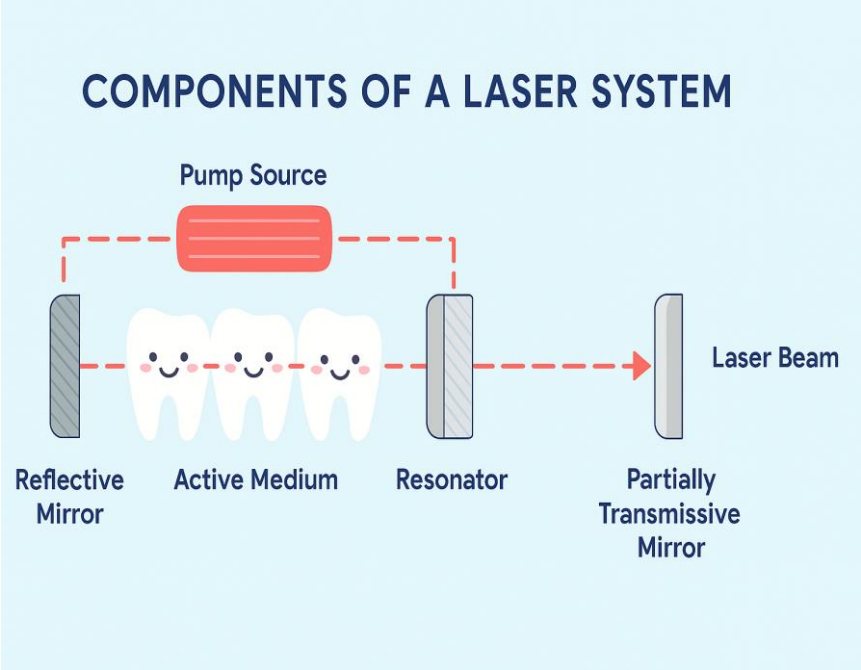

Figure 3: Components of the Laser system.

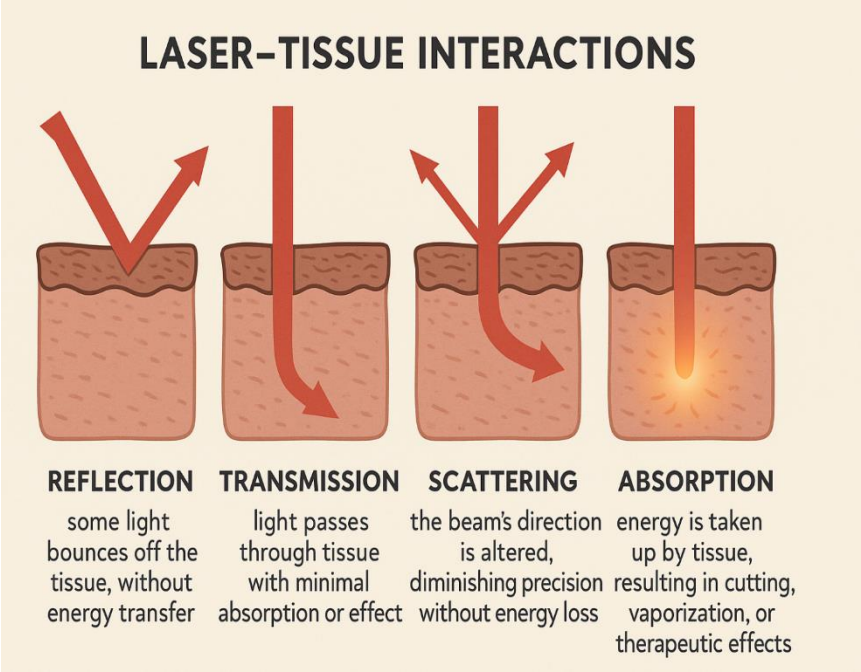

Figure 4: Laser-Tissue interactions

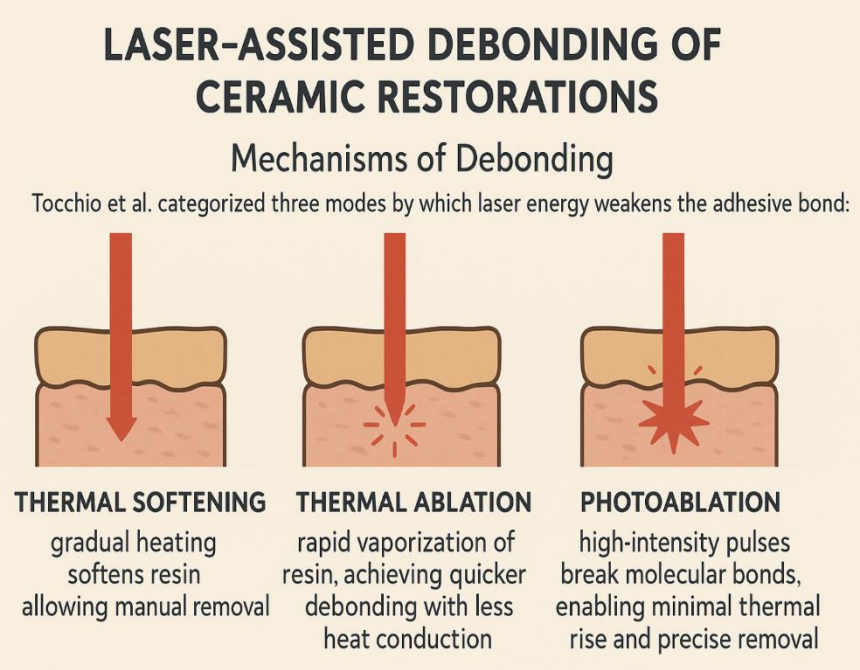

Figure 5: Mechanism of veneer debonding

All resin cements tested in this study exposed to Er:YAG laser irradiation and there were significant differences within the resin cements with regard to ablation volume. Volume loss varied according to the resin cements in test. Multilink Automix and G-Cem resin cements were statistically more affected by Er:YAG laser irradiation than other resin cements tested. Ceramic materials and dental hard tissues evaluated by light microscopy after debonding procedure and it was concluded that bond between ceramic restoration & tooth disrupted mainly at ceramic/cement interface, and majority of inner surface of ceramic veneer was free of resin cement [48].

Moreover, there were no ablation craters or slight marks of ablation on the tooth surface. Also, it was reported that laser debonding procedure does not alter the surface composition of dental ceramics [41]. During the debonding process of all-ceramic restorations, laser energy is transmitted through ceramic and then resin cement absorbs the finally transmitted laser energy [45-46]. In an invitro comparative study was carried out by H. Giraldo-Cifuentes, A. España-Tost, and J. Arnabat-Dominguez, veneers cemented on bovine teeth where irradiated by Er,Cr:YSGG (Waterlase iPlus®; Biolase, Irvine) at an energy density per pulse of 4 J/cm2, using a handpiece (Turbo; Biolase) with a sapphire tip (MX7) and applying the beam perpendicular to the specimen at a distance of 4 mm for 60 sec; experimental group 2 irradiated as in EG1, but at 2.7 J/cm2; and (c) control group (CG): debonding without laser irradiation. This resulted in a significant decrease in stress required for veneer debonding which was 8.19 MPa in CG, 0.91 MPa in EG1, and 0.48 MPa in EG2. The difference between control and both experimental groups was statistically significant ($p < 0.001$). Percentages of adhesive failure were 40%, 61.9%, and 96%, respectively [51].

It is concluding that Using the Er,Cr:YSGG laser at 4 or 2.7 J/cm2 requires significantly less force to debond ceramic veneers. The percentage of adhesive failures in the two experimental protocols was high. Application of the Er,Cr:YSGG laser using the parameters in this study may be useful in removing feldspathic ceramic veneers, avoiding damaging them and protecting the enamel. M. Hejazy, A. Shebl, M. Desoky, and M.A. El Gabrouny carried a study using, an epoxy resin dies that were duplicated from the prepared tooth, optical impression for each die, crowns were designed and Ten e-max CAD (shade A1), ten Vita Enamic (shade 1M2) and ten InCoris TZI (shade A1) crowns were milled, All the crowns were bonded to their corresponding dies; Crowns were debonded using Er, Cr: YSGG. Shade was measured before and after debonding for each group. The results showed that There was a statistically significant difference in the mean ΔE in the three tested subgroups ($P= 0.008$), concluding that the (InCoris TZI) and (e-max CAD) crowns, can rebond and reuse after Erbium laser debonding, on the contrary of the (Vita Enamic) crowns without great change in shade. the results obtained support the research hypothesis that lasers can affect the surface topography of certain ceramic materials affecting their optical properties [49].

However, the study tested for color changes in crowns immediately after debonding not testing the ability of the ceramic materials to retain their color after function in the oral cavity [51]. Adding to the previous findings; A. Abo Zaid, K. Ebeid, M. Wahsh, and M. El Demellawy conducted a study using materials IPS e.max CAD and Vita Suprinity, Celtra Duo, in 0.5 mm thickness plates and cemented on the labial surface of incisors using resin cement. The Er,Cr: YSGG laser was applied to each specimen at 4.5 W and 25 Hz for group E and at 6 W and 25 Hz. Color change (△E00), translucency parameter (TP) and surface roughness in µm (Ra) values were measured and calculated before and after laser treatment.All groups exceeded the perceptibility threshold but remained below the acceptability threshold. No statistically significant difference was found in translucency parameters except for group Emax CAD ($p = 0.019$). Ra values after laser debonding showed significantly higher values than before laser treatment in all three materials ($p <$

0.001). She concluded that: Er,Cr: YSGG laser can be safely used for debonding ceramic veneers without altering the optical properties but it does increase the roughness of debonded ceramic restorations [52]. These findings may be due to the varying microstructure of the different ceramics.

7.3. Laser–Material Interaction (Er,Cr:YSGG laser)

The Er,Cr:YSGG laser (2780 nm) wavelength is strongly absorbed by water and OH- groups, and interacts primarily via thermal effects, causing micro-explosions or vaporization at the surface. Materials with higher glass content (like e.max) tend to melt and reflow more smoothly when exposed to laser energy. In contrast, materials with higher crystal content and less glass may experience localized cracking, pitting, or grain pull-out when exposed to laser pulses, leading to:

- Higher surface roughness
- Microscale mechanical disruption of crystalline structure

Zirconia reinforcement makes the material harder and more brittle, and less able to absorb or dissipate thermal stress than e.max. Accordingly, the laser may etch or erode the boundaries between the zirconia and lithium silicate phases, creating differential wear and topography. Therefore, the higher crystal content, finer crystal structure, and lower glassy matrix make it less able to reflow under laser energy, and more prone to uneven surface damage, leading to increased surface roughness compared to e.max CAD after Er,Cr:YSGG laser exposure [53].

8. Clinical Considerations and Future Directions

Veneer thickness influences energy absorption; thicker ceramics attenuate more laser energy, necessitating adjusted settings or exposure times. However, S.I. Al-Araji, and A.R. Sulaiman found no significant effect on strength reduction, indicating effective debonding is achievable across common veneer thicknesses (0.5–1 mm) [46]. Enamel safety is supported by higher ARI scores and minimal pulp warming during laser debonding, affirming the technique's enamel-preserving potential [46-47]. Recent findings from Ain Shams University corroborate that Er,Cr:YSGG lasers can effectively remove lithium disilicate veneers with minimal damage, offering the possibility of reuse. However, further investigation is needed to assess whether laser exposure alters ceramic mechanical properties or optical qualities [50].

9. Conclusions

In summary, laser-assisted debonding, particularly using Er,Cr:YSGG systems, offers a minimally invasive, enamel-safe, and technically efficient method for removing ceramic restorations, with promising implications for restoration preservation and patient comfort.

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