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The Effect of Two Glazing Cycles on Two Lithium Disilicate Materials on Surface Roughness and Translucency

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Abstract

Lithium disilicate glass-ceramics are widely used in restorative dentistry because they combine favorable esthetics with mechanical performance and compatibility with digital fabrication. Advanced lithium disilicate materials, including CEREC Tessera, have expanded chairside processing options through accelerated firing workflows. This narrative review examines the relationship between different firing cycles and the surface roughness and translucency of conventional and advanced lithium disilicate ceramics, with emphasis on IPS e.max CAD and CEREC Tessera. The discussion is developed from the literature assembled in a master's thesis and selected supporting publications; it is a qualitative synthesis rather than a systematic review or meta-analysis. The review considers material composition, crystallization, glaze application, firing duration, surface measurement, optical assessment, and artificial aging. Published investigations indicate that glazing and thermal treatment modify surface and optical characteristics. Effects vary by material and experimental conditions. Evidence concerning different glaze techniques, repeated firings, or reduced firing duration should not be treated as direct evidence of the effect of firing cycles. Comparisons between conventional Programat and accelerated CEREC SpeedFire workflows require a constant glazing technique and careful reporting of material-specific firing schedules. Thickness, starting crystallization state, glaze coverage, and measurement geometry must also be controlled. Available evidence supports material-specific evaluation rather than a glazing-cycle-driven assessment. Further standardized studies measuring both outcomes before and after firing and aging are needed to clarify the clinical implications of accelerated processing.

Keywords: Lithium disilicate; CEREC Tessera; Furnace type; Surface roughness; Translucency; Firing cycles; Glazing cycles.

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1. Introduction

Achieving a natural appearance is a central objective of ceramic restorative dentistry; a successful restoration reproduces the optical characteristics and surface texture of the surrounding dentition while providing adequate mechanical performance. Translucency controls aesthetics and guides material selection [1-3]. Increasing demand for esthetic restorations, together with developments in dental materials and computer-aided design and computer-aided manufacturing (CAD/CAM), has expanded the use of all-ceramic systems, as improvements in CAD/CAM technology enable different ceramic materials with different contents to be used to meet patients' esthetic expectations [4]. Glass-ceramics have become widely used in restorative dentistry owing to their biocompatibility, chemical stability, favorable esthetic characteristics, and suitability for CAD/CAM, and glass-matrix ceramics have rapidly become the material of choice for indirect restorations because of their strength, chemical and physical resistance, translucency, and low thermal conductivity [5]. Their optical and mechanical properties are influenced by the composition of the glass matrix and the type, size, and distribution of the crystalline phases; all-ceramic systems differ in composition, microstructure, crystalline content, and phases, and an increase in crystalline content to achieve greater strength often results in greater opacity [4].

2. Dental Ceramics: Evolution, Classification, and Significance

Ceramics have been the mainstay of esthetic dentistry for more than 100 years, originally in the naturally occurring feldspathic form and used primarily as high-fusing porcelain jacket crowns, denture teeth, and partial coverage; beginning with McLean's introduction of aluminous porcelain in the mid-1960s, there followed continuous improvements in strength, esthetics, and methods of fabrication, resulting in dozens of products from which clinicians now choose [6]. Contemporary classification of these materials rests on the phase or phases present in their chemical composition. All-ceramic and ceramic-like restorative materials are categorized into three families: glass-matrix ceramics, polycrystalline ceramics, and resin-

matrix ceramics, depending on the presence of a glass-matrix phase, its absence, or the presence of an organic matrix highly filled with ceramic particles [6]. The glass-matrix family is further subdivided into naturally occurring feldspathic ceramics, synthetic ceramics, and glass-infiltrated ceramics, while polycrystalline ceramics are subdivided into alumina, stabilized zirconia, zirconia-toughened alumina, and alumina-toughened zirconia, and resin-matrix ceramics divided according to composition [6].

Polycrystalline ceramics are nonmetallic inorganic ceramic materials that do not contain any glass phase, which provides higher strength and fracture toughness relative to glass ceramics [7]. The classification proposed by Gracis and colleagues has been used in the dental literature since its publication and remains the reference framework against which subsequent updates — including those driven by the proliferation of zirconia systems and by new glass-ceramic compositions — have been proposed [7]. The clinical significance of this classification is direct. Current dental ceramic systems — leucite- or lithium disilicate-reinforced glass-ceramics, high-alumina, and zirconia ceramics — offer better physical and mechanical properties than older, more traditional systems [8]. Feldspar-based and leucite-reinforced ceramics, with their comparatively low flexural strength of 154 MPa and 160 MPa respectively, are indicated for single-tooth restorations such as veneers, inlays, onlays, partial crowns, and anterior and posterior crowns; zirconia-reinforced lithium silicate, at 420 MPa, extends to implant-supported crowns [8].

3. Glass Ceramics in Dentistry: Types, Properties, and Clinical Considerations

Among synthetic glass-ceramics, leucite-reinforced ceramic consists of leucite crystals at 35–45 vol% homogeneously distributed within the glassy matrix. Leucite crystals are created by the controlled firing of feldspar at 1150 °C, whereby potassium aluminium silicate disintegrates into leucite and two molecules of silica, a process known as surface crystallisation in which crystals grow slowly along grain boundaries toward the centre of the grain [9]. Zirconia-reinforced lithium silicate was developed to combine the optical properties of lithium disilicate with the enhanced mechanical strength of zirconia[10]. It consists of a lithium-metasilicate (Li_2SiO_3) glass–ceramic matrix reinforced with approximately 8–12% zirconium dioxide grains, presenting a fine-grained (Li_2O–ZrO_2–SiO_2) microstructure after crystallization [10]. This composition, combined with the homogeneous distribution of tetragonal zirconia grains, increases mechanical performance: unlike lithium disilicate, ZLS resists crack propagation because zirconia grains transform from the tetragonal to monoclinic phase, and the expansion of those grains from 3% to 5% in volume creates compressive stress in the microstructure that inhibits crack propagation [10]. Reported crystalline content is approximately 58 wt% crystals — 25 wt% lithium silicate and 11 wt% lithium disilicate — reinforced with 10 wt% zirconium oxide crystals, with an average flexural strength of 450 MPa [11]. Most in vitro studies demonstrate that ZLS restorations exhibit better mechanical properties than lithium disilicate ceramics but lower mechanical properties than translucent or high-translucency zirconia [10]. Increasing crystalline content of ceramic materials improves mechanical properties but results in higher opacity[4].

4. Lithium Disilicate Glass-Ceramics

4.1. Composition and Microstructure

Over the last 20 years, lithium disilicate-based glass ceramics have become widely used materials in esthetic and restorative dentistry, their combination of esthetics, high strength, and chemical and processing properties allowing use across a wide spectrum of indications [12]. Reported compositions of lithium disilicate glass-ceramics consist mainly of silicon dioxide at 57–80 wt% and lithium oxide (Li_2O) at 11–19 wt%, with minor constituents including Al_2O_3 (0–5 wt%), La_2O_3 (0.1–6 wt%), MgO (0–5 wt%), ZnO (0–8 wt%), K_2O (0–13 wt%), P_2O_5 (0–11 wt%), and approximately 8 wt% additives [13]. Other reports give the composition of lithium disilicate ceramics generally as 55%–80% silicon dioxide and 10%–30% lithium oxide[14]. Commercial CAD/CAM blocks are likewise based on SiO_2 with additional Li_2O, K_2O, MgO, Al_2O_3, P_2O_5, and other oxides [13]. Microstructurally, the chairside CAD/CAM version of lithium disilicate was introduced in 2006 and contains 32% lithium metasilicate and 62% glass, with crystals ranging from 0.2 to 1.0 μm; after crystallization the lithium metasilicate is converted to 59% lithium disilicate and 33% glass, with crystals 5 μm long and 0.8 μm in diameter [15]. In the fully crystallized material, up to 70% of the volume is occupied by the final lithium disilicate phase, the remainder comprising the glassy matrix and a minor amount of lithium orthophosphate crystals [12]. The crystallized structure, containing about 70% lithium disilicate orthorhombic crystal phase, is what provides the material's esthetics [4].

4.2. Manufacturing and CAD/CAM Workflow

Fabrication was carried out in three stages: In the first, the melted material is moulded and the block remains in the glass state; nucleation/pre-crystallization is then performed as a thermal pretreatment in which crystals begin to form and grow, and at this stage the material contains only lithium metasilicate crystals, which makes it easy to mill in the CAM unit [9]. The final crystallization stage is a short heat treatment – 850 °C – during which the restoration acquires its final colour and physical properties, with the crystalline phase consisting of lithium metasilicate and lithium disilicate crystals [9]. In the laboratory or chairside setting, the strength of the milled restoration increases as it is heated at 850 °C for 20–31 min, causing lithium metasilicate crystals to react with the surrounding silica through a solid-state reaction and form small, rod-like, interlocked lithium disilicate crystals 1.5 μm long [12]. During this final crystallization firing step the restoration also shrinks by 0.2%, usually compensated for automatically by the CAD software [12]. In the partially crystallized, bluish state the material is milled and subsequently transformed by heat treatment into the crystalline structure that provides esthetics [4]. Crystallization reduces brittleness and relieves stresses caused by machining, improving strength and fracture toughness while adjusting optical and aesthetic aspects [16].

4.3. Clinical Performance

The combination of esthetics, high strength, and chemical and processing properties allows lithium disilicate to be used from single-tooth restorations up to full-mouth rehabilitations by means of partial and full tooth coverage using inlays, onlays, veneers, and anterior/posterior crowns, as well as

tooth replacement with fixed partial dentures up to the second premolars, implant abutments, and implant crowns [12]. Reported flexural strength for lithium disilicate ceramic is 360–400 MPa, and its high crystalline content, specific microstructure, and strength permit use not only for single-tooth restorations but also for hybrid abutments, hybrid abutment crowns, and three-unit bridges up to the second premolar as the terminal abutment [9]. Jurado et al. compared the fracture loads of chairside CAD/CAM lithium disilicate ceramics and found that conventional, pre-crystallized IPS e.max CAD veneers had the highest mean value (640 ± 109 N), followed by pre-crystallized CEREC Tessera (503 ± 80 N), while fully crystallized GC Initial LiSi Block had the lowest (431 ± 130 N) [14]. In a separate study of anterior crowns after 120,000 thermal cycles, IPS e.max CAD also had a higher fracture load (1061 N) than GC Initial LiSi Block (920 N) [14]. Together, these findings provide a comparative benchmark for evaluating the fracture-load performance of conventional and newer CAD/CAM lithium disilicate materials.

5. Advanced Lithium Disilicate Ceramics

Advanced lithium disilicate CEREC Tessera was introduced in 2022 as a new CAD/CAM ceramic block that incorporates virgilite ($Li_{0.5}Al_{0.5}Si_{2.5}O_6$) and zirconia into a lithium disilicate glass-ceramic matrix [17]. CEREC Tessera is presented as a superior alternative to traditional lithium disilicate, although independent data supporting that claim are limited [11-18]. In this material, 0.5 μm long lithium disilicate crystals are embedded in a glassy matrix together with 0.2–0.3 μm platelet-like lithium aluminosilicate crystals, also known as virgilite [12]. The material is described as containing 90% lithium disilicate and 5% virgilite in a glassy matrix enriched with zirconia, with lithium disilicate crystals measuring 0.5 μm and virgilite crystals measuring 0.2–0.3 μm [14]. The mechanical rationale for virgilite is microstructural. Virgilite crystals form best between 800 °C and 850 °C, and their mismatch in thermal expansion compared with lithium disilicate crystals results in residual stresses or microcracks upon cooling; on the other hand, this also leads to crack-tip shielding, which enhances the toughness of the material [12]. The needle-like virgilite crystals are activated by matrix firing, which subsequently increases the material's density and mechanical properties by inhibiting crack propagation and preventing further fractures [17]. The reported strength values differed. The manufacturer claims that this material exceeds 700 MPa in biaxial flexural strength [12-19], wheres independent testing reported lower figures, such as a mean flexural strength of 544.86 ± 80.60 MPa for the same material [19].

This gap between manufacturer-reported and independently measured properties indicates the need for evaluation under defined processing conditions. Processing distinguishes this material from conventional lithium disilicate. According to the manufacturer, CEREC Tessera requires only an additional glaze firing — a matrix firing — of 4.5 to 12 min at 760 °C, which can increase the strength of the material, unlike conventional materials that must be crystallized [12]. It can be speed-fired in 4.5 minutes in the CEREC SpeedFire furnace versus regular-fired with up to 12.5 minutes in a conventional furnace [20]. Lien et al. reported lower flexural-fatigue strength for Tessera than for IPS e.max CAD. In flexural fatigue testing, the flexural fatigue strength values of the Tessera groups were 20.0–29.1% less than those of the IPS e.max CAD group, and the Weibull modulus of the IPS e.max CAD group was 43.6–63.5% greater than that of the Tessera groups, suggesting a more homogenous distribution of irregularities in the conventional ceramic and therefore a more consistent material [20]. The characteristic strength of IPS e.max CAD — that is, the strength at a failure probability of 63.2% — was 35.1–43.6% greater than that of the Tessera groups [20]. These findings do not coincide with the manufacturer's claim that Tessera is the "strongest glass-ceramic block currently on the market – up to 32% stronger", and they are consistent with a recent study by Lubauer et al. reporting that the fracture toughness of Tessera after firing was 28.9% less than that of crystallized IPS e.max CAD [20].

6. Glazing in Dental Ceramics

6.1. Definition and Distinction from Polishing

Glazing of ceramic restorations is a routine laboratory procedure which involves the provision of aesthetic and hygienic glass-coated surfaces to the finished restorations [21]. It is distinguished from polishing in that it involves the application and firing of a glass-based coating, whereas polishing is a purely mechanical finishing operation; polishing may be regarded as an alternative technique, and finishing and polishing systems have been shown to produce clinically acceptable results [22].

6.2. Purpose of Glazing

Glazing as a means of strengthening brittle glass can be considered the production of a surface layer of lower thermal expansion, which serves two functions: it places the surface into a compressive state and it reduces the depth and width of surface flaws, strengthening the material theoretically [21]. The self-glazing procedure is appropriate for clinical use as it provides the restoration with a smooth, hygienic surface, with specimens showing better color stability [21]. The relative effectiveness of glazing versus polishing is material-dependent: glaze powder/liquid applied after crystallization is the most effective way to reduce the surface roughness of lithium disilicate ceramics, whereas mechanical polishing after crystallization is most effective for zirconia-reinforced silicate ceramics [4].

6.3. Glazing Procedures and Application Techniques

Additive glazes are supplied as powder-and-liquid, ready-to-use paste, or spray, and the application technique is determined by the form selected. Powder-and-liquid glaze is mixed to a suitable viscosity and applied according to the manufacturer's recommendation [5]. Glazing may also be performed before or after crystallization, and this sequence affects the outcome [23]. Regardless of form, the objective is a uniform, dry, whitish glaze layer of controlled thickness; in one protocol a single experienced technician applied glaze to one surface of all specimens, with thickness verified by digital caliper. according to the manufacturer, for spray glaze, the container must be shaken well for approximately 20 seconds immediately before use, since insufficient shaking discharges mainly propellant and results in insufficient application, and the nozzle held approximately 10 cm from the surface, which is sprayed in short bursts while rotating the restoration until the layer is dry and whitish, with uneven areas resprayed.

Paste glaze is applied evenly with a brush, avoiding too thick a layer or pooling on the occlusal surface, since too thin a layer may give unsatisfactory gloss. Both over- and under-application affect the surface: too little produces insufficient gloss, while too much causes loss of surface texture. For IPS e.max CAD, the manufacturer describes two one-step options combining crystallization and glazing: crystallization/stain-glaze firing in one step with the crystallization/glaze spray, at most two restorations per cycle, duration 20 minutes; or crystallization/glaze paste applied to the uncrystallized, blue restoration using a 25-minute program. For CEREC Tessera, glazing is performed as a matrix (glaze) firing rather than a separate glaze cycle, with reported parameters of a closing time of 2 min, pre-heating at 400 °C, heating rate 55 °C/min, firing temperature 760 °C, and holding time of 2 min with vacuum off [23]. Speed-fire glazing for CEREC Tessera takes approximately 4 min and 30 s per cycle. Application sequence also influenced the outcome. In a single-step protocol, stain and glaze were applied together before firing; in a double-step protocol, spray glaze was applied and fired, specimens cooled to room temperature, then stain paste applied and fired again [18]. The two fabrication sequences, together with the total cycle duration reported for each furnace, are summarised in Figure 1.

6.4. Firing Cycles

Firing schedules differ substantially between material systems. For conventional lithium disilicate, the crystallization firing is performed at 850 °C for 20–31 min [12]. For advanced lithium disilicate, the manufacturer specifies a matrix firing of only 4.5 to 12 min at 760 °C [12]. The full parameter sets for both schedules, and the reported cycle durations, are compared in Table 1. The effect of glazing on the mechanical properties of lithium disilicate restorations is not uniform. Glazing in a second firing has been reported to weaken the biaxial flexural strength of conventional lithium disilicate, and a number of large pores have been detected under scanning electron microscopy at the interface between the lithium disilicate and the glaze layer, which act as stress concentrations under loading and weaken the mechanical properties of the glazed restoration [23]. This may be attributed to the fact that crystallized lithium disilicate presents less glass percentage and porosity than uncrystallized material, and the holding temperature of the second firing is lower than that of the first, conditions that might influence fusion of the glaze layer to the substrate [23]. Conversely, a healing effect has been described in refired glazed advanced lithium disilicate, where the glaze flows, sealing surface defects; as the glass component reflows it fills flaws, smooths sharp edges, reduces defect depth, and initiates a crack-healing process that dominates the ceramic's fracture behavior [18]. The manufacturer of advanced lithium disilicate claims that the glaze firing together with the crystallization is necessary to achieve its final strength and to close some defects during the manufacturing procedure, although the mechanism of strength improvement and repair is not clear [23].

7. Conventional Furnace Glazing versus Speed-Fire Glazing

Conventional and accelerated glazing protocols differ in their thermal schedules and processing duration [24]. Conventional firing is performed in a porcelain furnace such as the Programat, whereas accelerated firing is performed in an induction chairside furnace such as CEREC SpeedFire [25]. Speed-fire furnaces are capable of reaching high temperatures rapidly; the CEREC SpeedFire can take 15 min and reaches a fast sintering temperature of 1600 °C depending on size and volume of restoration [24]. Different protocols have accordingly been proposed to shorten clinical and laboratory time, to support CAD/CAM chairside systems, while heat treatment remains an important variable influencing mechanical properties [24]. Available evidence on equivalence mixed and material-specific. Table 2 summarises the studies that examined glazing and firing variables in relation to surface roughness, translucency, and related mechanical outcomes, and their findings are discussed below. Al-Haj Husain et al., in a systematic review of sintering protocols, compared a high-speed furnace protocol (26.2 min with pre-drying and proprietary firing parameters) against a conventional furnace protocol (4.3 h with a dwell time of 2 h at 1510 °C) and found no difference in flexural strength, flexural modulus, translucency, or opalescence [26].

Lien et al., examining advanced lithium disilicate specifically, found no statistically significant difference in flexural strength or flexural fatigue strength between regular- and speed-fired specimens [20]. Microstructural evidence indicates that the firing schedule alters crystal morphology. Kandil et al. reported that applying fast-firing cycle to conventional lithium disilicate revealed smaller, rod-shaped lithium disilicate crystals densely concentrated within glass matrix, and that fast-firing cycle generally resulted in smaller and more condensed crystal grains; authors further noted that advanced lithium disilicate processed under fast-firing cycle exhibited fine-grained lithium disilicate crystals irregularly arranged among virgilite crystals [19]. Because the microstructure of dental ceramics is a key factor determining their translucency and overall esthetics — although translucency is also influenced by pores, secondary phase components, additives, refractive index, and light scattering from surface — such schedule-induced differences in crystal size and arrangement may affect optical outcome [18].

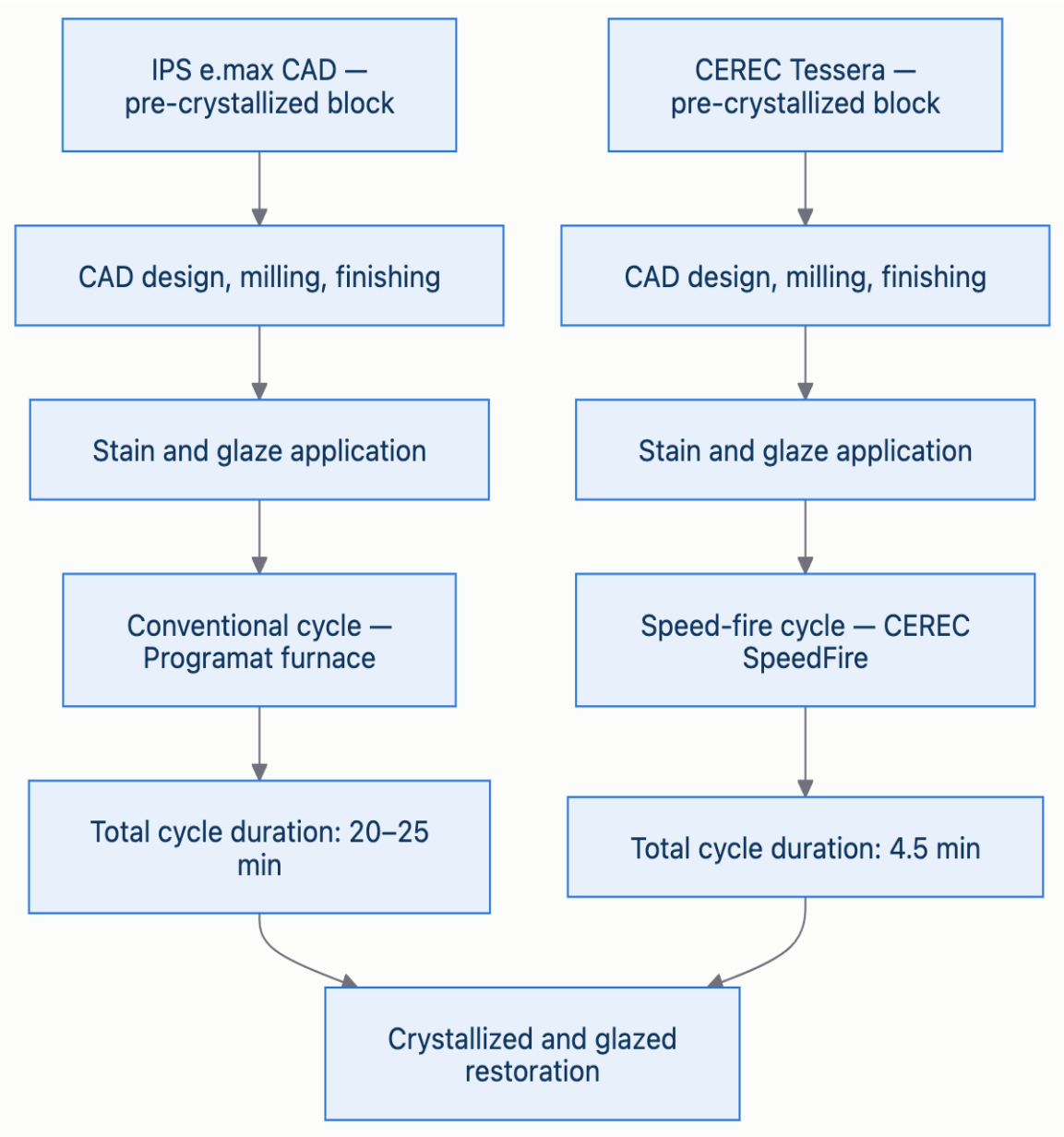


Figure 1: Schematic comparison of the conventional and speed-fire firing cycles for lithium disilicate restorations, showing workflow sequence and total cycle duration.

Table 1. Comparison of conventional and speed-fire firing parameters and cycle duration in lithium disilicate ceramics [25]

Material	Crystallization	Glaze firing	Cycle duration
Advanced Lithium Disilicate	Not required	Stand by temperature: 400 °C; pre-drying time: 2 min; closing time: 2 min; pre-heating time: 2 min; heating rate: 55 °C/min; firing temperature: 760 °C, holding time: 2 min	4.5–10 min
Lithium Disilicate	Stand by temperature: 403 °C; closing time: 6 min; heating rate: 60 °C/min; firing temperature: 770 °C; holding time: 0:10 min; heating rate: 30 °C/min; firing temperature: 850 °C; holding time: 10:00; long-term cooling: 700 °C; vacuum on/off: 770/850	Stand by temperature: 403 °C; closing time: 6 min; temperature increasing rate: 60 °C/min; holding temperature: 725 °C; holding time: 1 min; vacuum on/off: 450/724 °C	20–25 min

Table 2: Summary of studies examining glazing and firing variables in relation to surface roughness, translucency, and related mechanical outcomes in dental ceramics

Study	Materials	Glazing / firing variable	Outcomes assessed	Key findings (relevance to review topic)
Lu et al. (2023) [23]	CEREC Tessera; IPS e.max CAD	Crystallization (c); crystallization + second firing (c-r); crystallization + glaze in one step (cg); crystallization then glaze firing (c-g)	Surface roughness (profilometer); flexural strength; SEM, crack healing	Refiring alone did not change roughness, but adding a glaze layer (cg or c-g) increased it. Separate glaze firing lowered conventional LD strength, whereas ALD was stronger when crystallization and glazing were combined. Refiring fully healed an introduced crack in ALD but only partially in LD. One-step glazing was rougher than two-step for LD; the two were similar for ALD.
Demirel et al. (2022) [25]	CEREC Tessera (normal vs reduced glaze duration); IPS e.max CAD; Vita Suprinity	Reduced vs normal glaze duration; coffee thermocycling	Colour change; relative translucency parameter; biaxial flexural strength	Colour change was similar across materials. Conventional LD had the highest RTP before and after thermocycling and was the only material whose translucency did not change ($p = 0.865$). Advanced LD with normal glaze duration was more translucent than the reduced-duration version. Normal-duration glazing also gave higher strength; reduced glazing duration lowered both translucency and strength of the advanced material.
Abuhammoud et al. (2025) [15]	Virgilite-containing LD; glazed IPS e.max CAD	Glazing vs zirconia polishing kit vs lithium disilicate polishing kit	Surface roughness (profilometer, AFM)	Glazed Tessera had the roughest surface ($Ra = 51.98 \pm 12.31$ μm) and glazed e.max CAD the smoothest (10.03 ± 5.03 μm). Both polishing kits gave Tessera significantly smoother surfaces than glazing (zirconia kit: 15.44 ± 9.69 μm). Glazed Tessera differed significantly from all other groups; the three smoother groups did not differ from one another.
Rizk et al. (2024) [29]	Virgilite-containing LD at 0.5 mm and 1.0 mm	1, 3, and 5 firing cycles	Translucency; colour change; biaxial flexural strength; XRD/EDX/SEM	Repeated firing reduced translucency, increased colour change, and lowered strength at both thicknesses. At 0.5 mm, both 3 and 5 firings reduced translucency; at 1.0 mm only 5 did. Thicker specimens were less translucent throughout. Repeated firings should be avoided.
Rizkallah et al. (2025) [18]	Advanced LD containing virgilite	Glaze only vs single-step vs double-step characterization; 2, 4, and 6 firing cycles	Translucency; colour change; biaxial flexural strength; SEM	Translucency increased with firings (highest in the glaze-only group, lowest with double-step), but colour change also increased with firings. Strength was stable in the control, rose to a peak at six cycles with single-step, and peaked at four cycles then declined with double-step; by six cycles all groups were comparable. More firings improve translucency at the cost of colour.
Padunglappisit et al. (2025) [17]	Lithium disilicate-based glass-ceramics including IPS e.max CAD and CEREC Tessera	Multiple firing cycles	Colour; biaxial flexural strength (also microhardness and shear bond strength, outside this review)	Colour change became noticeable by the third firing cycle, particularly for Tessera, and mechanical properties peaked at the second firing; no more than three firing cycles were recommended. Only the colour and flexural-strength findings bear on this review's outcomes.
Kandil et al. (2025) [19]	IPS e.max CAD; CEREC Tessera; Initial LiSi	Normal vs fast crystallization	Biaxial flexural strength; Vickers hardness; SEM	Normal crystallization gave slightly higher strength (not statistically significant) and significantly higher hardness than fast firing. e.max CAD had the greatest strength in both modes; under fast firing Tessera had the highest hardness. The topic-relevant link is microstructural — fast firing produced smaller,

				more densely packed crystals. Neither roughness nor translucency was measured.
Hassan et al. (2025) [28]	IPS e.max CAD; CEREC Tessera	Programat CS3 vs CEREC SpeedFire	Translucency (contrast ratio)	Only material type significantly affected translucency ($p < 0.001$); furnace did not ($p = 0.630$). e.max CAD (0.62 ± 0.02 in Programat CS3; 0.64 ± 0.04 in SpeedFire) was significantly more translucent than Tessera (0.70 ± 0.05 in both furnaces). Firing the same material in either furnace made no significant difference.
Koç et al. (2024) [16]	IPS e.max CAD; CEREC Tessera; Initial LiSi Block at 1.2 mm	5000 thermocycles plus 30 days coffee immersion	Relative translucency parameter	Materials differed significantly before and after staining ($p < 0.001$). Tessera had the highest RTP both before and after staining, while e.max CAD had the lowest before staining and was no longer significantly different from Initial LiSi Block after staining ($p = 0.781$).
Abd El-Rahman et al. (2025) [5]	Advanced LD with virgilite	Mechanical polishing; powder glaze; clear glaze paste; glaze paste; 5000 thermocycles plus coffee immersion	Colour stability (roughness and translucency not assessed)	Glaze type significantly affected color change ($p < 0.001$). Glaze paste performed best ($\Delta E = 3.37$, within the acceptability threshold), followed by clear glaze paste (3.98) and powder glaze (4.6); mechanical polishing was worst (5.1). Glazed surfaces resisted discoloration better than polished ones. Because only color was measured, this supports the review indirectly.
Lien et al. (2022) [20]	Advanced LD; IPS e.max CAD	Glazed vs unglazed; regular-fired vs speed-fired	Flexural strength, flexural modulus, fatigue strength, Weibull modulus, characteristic strength	Tessera showed no significant difference in flexural or fatigue strength whether glazed, unglazed, regular- or speed-fired, though glazed regular-fired specimens had the greatest characteristic strength. e.max CAD had significantly greater strength than all Tessera groups and the highest Weibull modulus (14.05), with a flexural modulus of 103.15 ± 9.51 GPa. The authors concluded their results do not support the claim that the advanced material is the strongest glass-ceramic block.

8. Optical Properties: Translucency and Measurement

Translucency is the degree of light transmission through a material, ranging from complete opacity to transparency; greater light transmission indicates higher translucency [1]. When the color of a restoration is combined with proper translucency, the restoration can closely match the surrounding tooth structure [1]. Translucency is an essential factor in the proper selection of ceramic material and in controlling natural esthetics, and it depends on light scattering and absorption, grain size and thickness, additives, density, porosity, and the sintering process [27]. When measured using a spectrophotometer or colorimeter, the translucency parameter is typically calculated by determining the difference in color coordinates between the material backed by a black surface and a white surface [27]. Methods for quantifying translucency include direct transmittance of light, the translucency parameter, and the contrast ratio; despite these options, there is no standard or consensus on the method of choice for quantifying the translucency of aesthetic restorative materials [1]. Translucency parameter calculated as the color difference of specimens over black and white backgrounds using the equation $TP = [(Lb^* - Lw^*)^2 + (ab^* - aw^*)^2 + (bb^* - bw^*)^2]^{1/2}$, where the subscripts refer to color coordinates over black and white backgrounds respectively. Contrast ratio is calculated as $CR = Yb/Yw$, where Yb signifies reflectance measured against black background and Yw reflectance against white background; a contrast ratio of 0 represents maximum translucency and a ratio of 1 represents maximum opacity [28]. The two parameters show a strong correlation: as TP decreases, CR increases [1].

9. Surface Roughness: Definition, Importance, and Measurement

Surface roughness describes the irregularities of a finished ceramic surface and is commonly expressed as average roughness or ten-point height, which are considered reliable indices of surface roughness [30]. The parameter is clinically consequential because a surface roughness of less than 0.2 μm is required for both natural teeth and restorations as the threshold of bacterial accumulation, and polishing and/or reglazing should be performed to smoothen the surface of a ceramic restoration [22]. Where surface roughness falls below this threshold, bacterial retention is considered unlikely [22]. The surface quality of dental ceramics also

influences the formation of bacterial biofilm, and the adherence of microbial species to ceramics and subsequent biofilm formation on rough surfaces may be contributory factors to plaque-related systemic diseases [21]. A profilometer is used for quantitative measurement of surface roughness, but because the instrument scans only some parts, the roughness values are not always definitively representative of the actual topography of ceramic surfaces; scanning electron microscopy is therefore also recommended to obtain more comprehensive results [22]. The effect of finishing method on surface roughness depends on the ceramic substrate. Rashid reported that glazing can produce an undulating and rough surface that usually has irregularities, inducing more adhesion of bacteria and other substances, and that glazed surfaces have been reported to be rougher than polished surfaces [21]. In contrast, glazing has also been reported to decrease roughness; Manziuc et al., in a study of monolithic zirconia, found that glazing influenced roughness with Ra decreasing for all materials [27]. These differences may be attributed to the ceramic substrate, the glaze material, and the firing conditions; glaze quality, rather than the mere presence of a glaze layer, determines whether roughness is reduced. Finally, surface roughness and translucency are not independent. An increase in surface roughness reduces translucency, which links the surface state produced by finishing and firing directly to the optical performance of the restoration [4].

10. Conclusions

The literature reviewed here supports three conclusions. First, the properties of glass-ceramic restorations are determined jointly by composition and by processing: the type, size, distribution, and volume fraction of the crystalline phase set the ceiling on optical and mechanical performance, but the thermal schedule that produces that microstructure is equally determinative[4-19]. Second, glazing is not a neutral finishing step. It can seal defects and generate beneficial compressive stresses, yet it can also introduce interfacial porosity, roughen rather than smooth the surface, and weaken the underlying ceramic depending on substrate, glaze, and firing parameters [23-27]. Third, accelerated processing has been shown to alter crystal morphology and to produce surface and optical outcomes that are material-specific rather than uniformly equivalent to conventional firing [19-26]. Advanced lithium disilicate has not been fully evaluated.

Its virgilite phase and accelerated matrix firing offer workflow advantages, yet manufacturer-reported strength values exceeding 700 MPa are not corroborated by independent measurements, and pre-firing surface analysis reveals fissures of varying depth that heat treatment is expected to address [11-12]. Since glazing is the very step claimed to close these defects and deliver final strength, the glazing and firing protocol is a central variable in the performance of this material [18-23]. Accordingly, a controlled in vitro comparison of conventional and advanced lithium disilicate processed under a constant glazing technique but different furnaces – a conventional porcelain furnace versus an induction speed-fire furnace – would address a clear gap: whether accelerated firing yields surface roughness and translucency comparable to those obtained with conventional firing, and whether the two materials respond equivalently [20-25]. Surface roughness and translucency are appropriate outcome parameters for such a comparison because both are influenced by material characteristics and processing conditions, and because roughness has a demonstrated effect on translucency [4].

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