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Lithium Disilicate CAD/ CAM Ceramics

What's Next?

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As restorative dentistry aims to preserve and maintain the maximum amount of the natural tooth structure from a biomimetic perspective, cases should be treated conservatively to prevent unnecessary removal of sound tooth structure, as preservation of tooth structure is the key to sustaining the subtle balance between biological, functional, mechanical, and esthetic considerations. Altogether with the increased esthetic demands by the patients, all-ceramic restorations had been adopted for such purposes [1,2]

CAD/CAM technology has become an established fabrication process for dental restorations, especially all-ceramic restorations. This technology eliminates the errors found in the conventional methods, producing a restoration with better accuracy and marginal fit. In recent years, there has been a trend toward the use of monolithic restorations to avoid any chipping of veneering ceramic. The users of CAD / CAM systems were the ones who demanded industrially prefabricated ceramics with clearly defined properties, suitable for chairside grinding in one appointment. A controlled, uniform structural quality characterizes these industrial ceramic blocks. This is important when using ceramics, because every pore, every irregularity, may cause cracking and lead to the failure of restoration.[3,4]

At a microstructural level, ceramics can be identified by their composition nature of glass–crystalline ratio into: **Glass-based ceramics** which best mimic the optical properties of enamel and dentin and have a high glass content and **Glass-based ceramics with fillers** usually crystalline added to the glass-based composition by the manufacturers to improve mechanical properties, such as strength and thermal expansion and contraction behaviour. [5]

Lithium Disilicate-Based CAD/CAM Blocks

Chairside Aesthetic Lithium Disilicate-Based CAD/CAM Blocks **IPS e.max CAD** are among the products that entered the market, where the alumino-silicate glass has lithium oxide added and has been utilized by clinicians for the fabrication of posterior and anterior restorations because of its superior mechanical and esthetic properties. They are stronger than feldspathic porcelain, machinable, etchable by hydrofluoric acid and easily bonded to tooth structure.

Figure (1) Lithium Disilicate-Based **IPS e.max CAD** ceramic Blocks

Figure (2) Zirconia-reinforced lithium silicate ceramic (ZLS) **Celtra Duo** ceramic Blocks

All the aforementioned advantages expanded their indications to include minimally invasive tooth repairs. [6-8] figure (1)

However, the ongoing search for advancements never stops and has led to the emergence of other variations of the Lithium disilicate ceramic system. The manufacturers of each material have claimed that they have better clinical and technical properties. So what to expect more?

Zirconia-reinforced lithium silicate ceramic (ZLS)

zirconia has been added to lithium silicate ceramic (referred to as zirconia-reinforced lithium silicate or ZLS). It was introduced to the market with the advantage of being compatible with CAD/CAM technologies. It was suggested that this structural composition offers satisfactory optical properties and enhanced mechanical behaviour compared to other glass-ceramics. Since ZLS is highly transparent and has strong biaxial flexural properties, it has been used for implant-supported restorations and tooth esthetic restorations, including veneers. [9] figure (2)

With a composition of fully crystalized lithium silicate glass ceramics Reinforced with 10% by weight zirconia which can be used for fabrication of high-strength single unit restorations such as crowns, inlays, onlays, and veneers partial coverage crowns through CAD/CAM technique. The incorporated zirconia will increase the fracture toughness via the stress-induced toughening mechanism that prevents crack propagation.[10]

The specific composition has a positive influence on the optical properties of this material and provides a natural esthetic appearance (natural opalescence, fluorescence and pronounced chameleon effect). The nano-sized lithium silicate crystallites provide excellent polishing properties and also correspond to the wavelength range of natural daylight thus mimicking the opalescence behaviour of the tooth enamel, and together with the high glass content are responsible for the fluorescence of the restoration. [11]

Another technical advantage of post-milling processing that might affect restoration fit is not required. Restorations do not need oven firing as do lithium disilicate ceramic CAD/CAM restorations, so decreasing the chair-side time for fabrication and decreasing any marginal gaps that could occur due to heating.[12]

The following figures represent a patient who had his anterior teeth continue to wear and was also looking for improvement in appearance of his front teeth. figure (3), recently restored Teeth #7-10 with Zirconia-reinforced lithium silicate ceramic (ZLS) **Celtra Duo** LT A3 fired, completed in two visits using biogeneric individual figure (4), Restorations were adhesively bonded with the same adhesive protocol for Lithium Disilicate-Based ceramic restorations. They were cleaned in an ultrasonic cleaning device using distilled water for one minute and treated with hydrofluoric acid etch gel for)

Figure (3) Initial situation teeth (courtesy of Andrew Hall) .[13]

Figure (4) Teeth #7-10 Prep pics & biogeneric Design using CEREC software

20 seconds then rinsed with air water oil-free spray. After etching and rinsing the ceramic silane primer was added for 60 seconds finally the resin cement (neutral) was applied. Figure (5).

Advanced lithium disilicate (ALD) ceramic block

Virgilite-based lithium disilicate glass-ceramic is a newly introduced innovative material through a unique chemistry that incorporates two complementary crystal structures within a glassy zirconia matrix. To create fusion of strength and esthetics in one block while improving overall processing time. Figure (6)

It has a flexural strength of 700MPa and can be used for single-unit full contour crowns, inlays, onlays, and veneers even at wall thicknesses down to 1.0 mm. and can be both adhesively bonded and conventionally cemented based on the preparation guidelines.

Another clinical advantage with true shade blocks that match the final restoration with no specialized selection tools or guesswork required. The result is a dynamic esthetic that relies on the properties of light refraction, transmission, and absorption making it the ideal choice for the most highly visible esthetic restorations.

Finally, Speed Fire technical advantage with Faster total processing time, as it arrives already partially crystallized, enable faster firing requiring only 4.5 minutes in a Speed Fire furnace, even with stains. which can save up to 44% of total processing time (grinding and firing), **redefining the possibilities of single-visit dentistry.**

This case highlights the minimally invasive rehabilitation with a new advanced lithium disilicate (ALD) **CEREC Tessera** ceramic block. resulted in an aesthetically pleasing, functional outcome that improved overall treatment time and increased patient and practitioner satisfaction, which remained stable over a one-year follow-up period.[14] Figure (7).

Defect-oriented preparation, minimum wall thicknesses recommended by the manufacturer (1.5mm for occlusal and 1.0 axial walls) were strictly adhered to and internal line angles were rounded. The preparation was free of undercuts, all line angles were rounded, a taper of approx. 6°–10° relative to the occlusal surface was prepared, and the margins were not located in occlusal contact points . Figure (8).

The software used in the biogeneric individual mode presented a restoration design for the missing occlusal surfaces. A modification of the restoration design was only necessary by adjusting the occlusal and proximal contacts. Figure (9)

Figure (5) post-operative final Photos

Figure (6) Advanced lithium disilicate (ALD) **CEREC Tessera** ceramic block

Figure (7) Initial situation (courtesy of Hölken & Dietrich case report)

After milling , the restorations were checked for accuracy of fit and occlusal contacts on a printed model and adjusted where necessary . Then the restorations were individually stained and glazed for furnace firing. Figure (10)

Restorations were adhesively bonded and conventionally cemented based on the prep guidelines. Conventional Cementation with RMGI Cements for full crowns with 1.5 mm occlusal/axial reduction, adhesively bonded for 1.0 mm full crowns with occlusal/axial reduction and inalys / onlays and veneers.

At the follow-up visit, the patient was very satisfied with the esthetic results of the treatment. To prevent excessive stressing of the restorations, a relaxation splint to be worn at night was made. The esthetic, functional occlusion and gingival tissue remained stable over a follow-up period of 6 months and 1 year. No signs of fractures within the restorations were observed. Figure (11)

The newly introduced ZLS & ALD ceramics produce an esthetically pleasing and clinically accepted restoration with technical advantages optimizing the chairside workflow.

Figure (11): Restorations placed on teeth 44, 45, 46, and 47.

Figure (8): Cavity preparations and bases in the mandible.

Figure (9): Digital design for teeth; CEREC SW5.1.3.

Figure (10): Finalization of the restorations on teeth no. 47, 46, 45, and 44 on a printed model.

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Egyptian Prosthodontic Association (EPA)

Address: 15 Ahmed Abo El-Ela St. – 8th district Nasr City, Cairo Egypt.

Mobile : 010 28203484 (Calls & Whatsapp) Phone: 02 26705035