DENTSPLY

CELTRA™ DUO
Dental Ceramic

FACTFILE

The product name CELTRA™ stands for a new generation of high-strength dental ceramic and defines a new class of material referred to as "zirconia-reinforced lithium silicate ceramic" (ZLS). CELTRA™ will be available as pressable, veneering and CAD/CAM variants.
CELTRA™ Duo is a CAD/CAM block developed specifically for chairside use with CEREC*.

Properties of zirconia-reinforced lithium silicate ceramic (ZLS)

In addition to lithium oxide and silicon dioxide, CELTRA™ contains approximately 10% zirconium dioxide (ZrO_2) in highly dispersed form in the glass phase of the ceramic. This prevents crystallization of the zirconium oxide, lends this new class of materials its high translucency and opalescence and avoids the more opaque look one is used to with zirconium oxide ceramics. Furthermore, the highly dispersed ZrO_2 content generates considerably more nuclei for forming the crystallization phase and already encourages the formation of crystallization nuclei at lower energy input due to its more favorable thermodynamic parameters (Fig. 1). This tends to result in a greater number of smaller crystallites rather than fewer large ones, which is why the glass phase of the ZLS glass ceramic is present at a higher ratio when compared with conventional lithium disilicate ceramics. The formed crystals (Fig. 1, right: approx. 0.6-0.8 µm) are significantly smaller than those in lithium disilicate ceramics (Fig. 1, left: 2.5 µm).

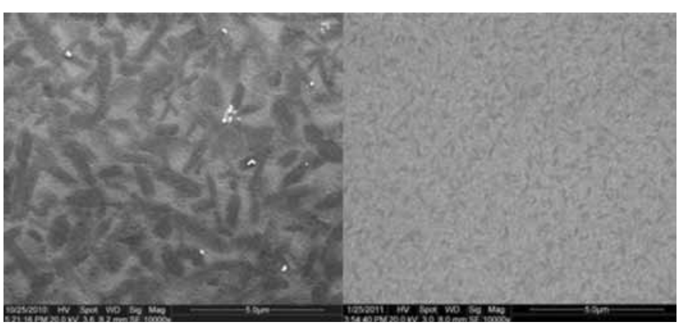

Fig. 1 Scanning electron micrographs of polished ceramic samples
left: lithium disilicate with predominantly large crystals (dark)
right: ZLS with fine crystalline structure (dark) and large glass ratio (light)

The 10% content of zirconium oxide is virtually dissolved at the molecular level. The resulting structural characteristics in ZLS lead to the special properties of this material class:

- High intrinsic strength of 420 MPa[1]
- Easier grinding and polishing in crystallized state
- High level of translucency and opalescence resulting in excellent esthetic properties

What is CELTRA™ Duo?

CELTRA™ Duo is a CAD/CAM block based on the above described properties of ZLS developed specifically for chairside use with CEREC* .
Due to the easier grindability of ZLS, CELTRA™ Duo can be processed in the grinding unit of the CEREC* system in its crystallized state. Because crystallization firing is not necessary CELTRA™ Duo can be polished and adhesively incorporated immediately after grinding, which lends itself especially for the preparation of inlays and onlays. Due to the high intrinsic strength 420 MPa[1] in its delivered state, it still demonstrates a strength of 210 MPa[1] after processing in the CEREC* grinding unit, which lies above that of conventional glass ceramic (Fig. 2). The original intrinsic strength of 420 MPa[1] in the delivered state can almost be completely retained at 370 MPa[1] by glaze firing (Fig. 3). The latter is particularly suited for the fabrication of crowns.

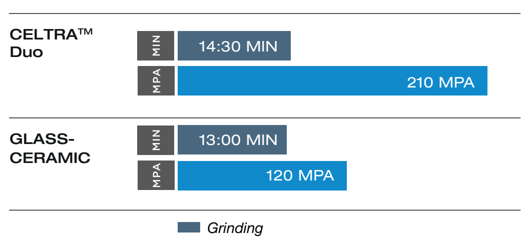

Fig. 2 Mean strength (MPa) and processing times (min.) of CELTRA™ Duo (standardized posterior crown with block size 14) compared with conventional glass ceramics[1]

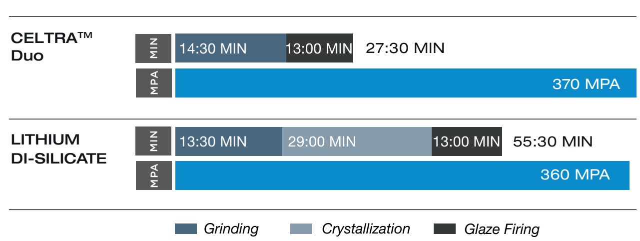

Fig. 3 Mean strength (MPa) and processing times (min.) of CELTRA™ Duo (standardized posterior crown with block size C14) compared with lithium disilicate ceramics[1]

CELTRA™ Duo compared to other systems
Esthetic properties

CELTRA™ Duo is available in the variants HT (high translucency) and LT (low translucency). During development, the HT blocks were adapted for the fabrication of inlays, and the LT blocks for the fabrication of crowns. At first glance, the CELTRA™ Duo blocks may appear somewhat darker or more chromatic than accustomed to by experienced CEREC* users (Fig. 4). This is due to the material-immanent opal effect and the shading selected in terms of desired dental restoration (Fig. 4).

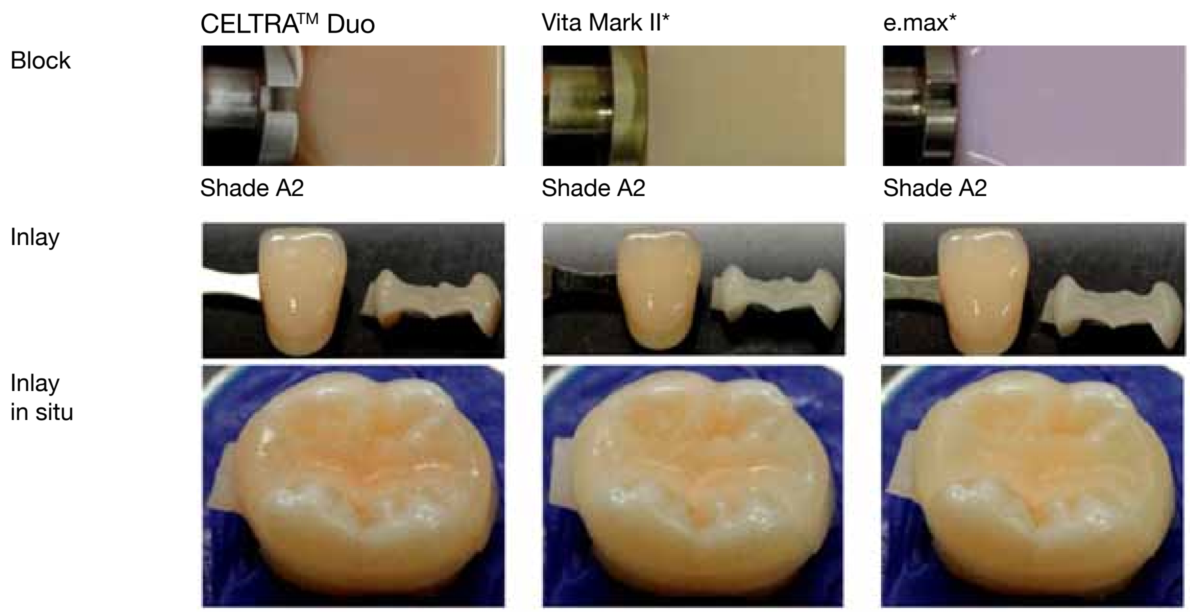

Fig. 4 Chameleon effect of CELTRA™ Duo based on high translucency and opalescence. It should be noted that the block initially appears somewhat darker, but that the ground restoration then meets the tooth shade to be achieved.[3]

Mechanical properties

In a study at Heidelberg University, anterior crowns made of CELTRA™ Duo (glazed), lithium disilicate (e.max*) and feldspar ceramic (Vita Mark II*) were loaded orally at the incisal edge. The crowns were fixed to CoCr cores using a composite cement. One half of the samples was tested for static strength, the other half was loaded mechanically 1.2 million times at an average load of 70 N following thermocycling (6.5°C/60°C 10,000 cycles). Then the strength of the crowns was tested mechanically until complete failure. Not only was the breaking strength tested here (Fig. 5), the incidence of first defects in the framework was also recorded via acoustic detection, i.e. cracks which already occur during lower loads. This test showed that first cracks or damage prior to ageing for CELTRA™ Duo occurred at considerably higher loads (667 N) than for lithium disilicate (525 N). After aging, CELTRA™ only showed first cracks at 742 N, whereas with lithium disilicate they already occurred at 402 N. CELTRA™ Duo demonstrated no statistically significant drop in loading capacity after aging when using glaze ("aged" from previously 725 N to 766 N) in this simulation of chewing compared to lithium disilicate (aged from previously 701 N to 485 N) and feldspar ceramic (aged from previously 554 N to 372 N).

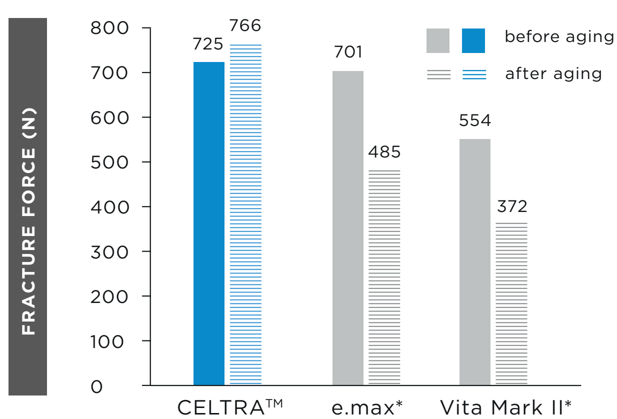

Fig. 5 Breaking load in Newton (median) for anterior crowns after 1.2 million cycles of mechanical loading of the incisal edge orally prior to and after thermocycling
(TC, 60°C/6.5°C)[2]

Technical data on CELTRA™ Duo

	CELTRA™ Duo directly from the CEREC MCXL* and **polished**	CELTRA™ Duo **with glaze firing**
CTE 500°C [*10^{-6} 1/K]	approx. 11.8	
Intrinsic flexural strength ex works [MPa]	420	
Flexural strength [MPa]	210	370
E-modulus [GPa]	approx. 70	
Crack resistance (SENVB) [MPa·$m^{-0.5}$]	2.0	
Hardness [HV]	approx. 700	
Chem. solubility [µg/cm²]	< 40 (intrinsic)	< 20 (solubility glazing)
Crystallization temperature [°C]	already fully crystallized	
Softening temperature [°C]	approx. 800	
Transformation temperature [°C]	approx. 620	
Density [g/cm³]	2.6	

Adhesive luting with the CELTRA™ Cementation System

The CELTRA™ Cementation System consists of the Etch&Rinse Adhesive XP BOND®, the corresponding Self Cure Activator and the composite cement Calibra® in the shades translucent and medium. The Self Cure Activator ensures that the actual light curing XP BOND® combines with the dual and chemical curing composites. In combination with Calibra® this results in a dual-curing cementation system where separate light curing of the adhesive layer can be dispensed with in favor of fitting.

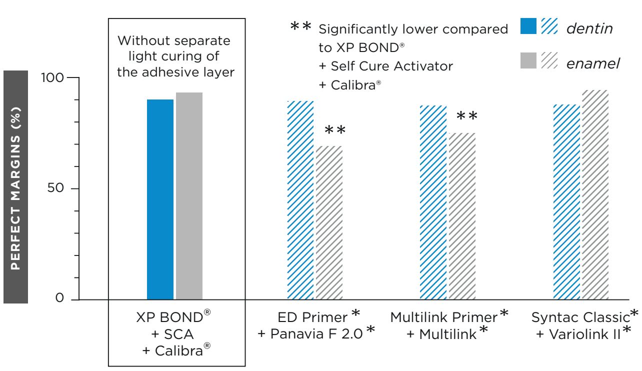

Fig. 6: Proportion of perfect margins in dentin and enamel for ceramic inlays following chewing simulation with thermo-mechanical loading.[4]

In addition, silane is included for pretreating the CELTRA™ Duo restoration and etch gel for use prior to the adhesive in the Etch&Rinse technique.

Doubts often arise as to whether an adhesive can develop sufficient bond strength when dispensed with separate light curing of the adhesive layer. Frankenberger et al.[4] therefore investigated the marginal quality of ceramic inlays which were luted with different cementation systems. The samples were subjected to a 100,000 cycle thermo-mechanical loading test ("Quasimodo" chewing simulator, University Erlangen). It was shown that XP BOND® + Self Cure Activator + Calibra® demonstrated no significant difference between chemical and light curing. The difference to Variolink II* + Syntac* was also not significant. However, marginal analysis showed significantly better results for XP BOND® + Self Cure Activator + Calibra® than for the systems Panavia F2.0* and Multilink* (Fig. 6) which were also tested.

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¹ internal measurements, 3-point flexural strength, data available upon request
² Rues, D. Müller, M. Schmitter, University Heidelberg 2012, data available upon request.
³ Results of a user study with a total of 125 restorations, results available upon request.
⁴ Frankenberger R, et al., Luting of ceramic inlays in vitro: Marginal quality of self-etch and etch-and-rinse adhesives versus self-etch cements, Dent Mater. 2008 Feb;24(2):185-91
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