# Celtra® Duo

## Zirconia-reinforced Lithium Silicate (ZLS) Block

# Clinical Evaluation Summaries

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## Clinical Evaluation of Chairside Fabricated Posterior Partial Crowns – 24-months Results

Rinke S, Pfitzenreuter T, Roediger M, Ziebolz D. Oral Session: International Association for Dental Research, March 22, 2017.

### Objective of Study

Zirconia-containing lithium silicate (ZLS) ceramics are a new material group, characterized by a high mechanical capacity and good optical properties. Up to now, data on the clinical performance of this type of restorations are sparse. Based on this background, CAD/CAM-fabricated monolithic partial ZLS crowns were evaluated in a practice-based prospective study.

### Key Finding / Analysis

Seventy-one patients (45 female/25 male, age at insertion: 49.0±13.0 years) were restored with 89 partial premolar and molar crowns. All abutment teeth were asymptomatic and vital, or sufficiently treated. Patients did not show any signs of craniomandibular dysfunctions or bruxism. The monolithic restorations were fabricated chairside (CEREC® SW 4.2/CEREC MC XL, Dentsply Sirona, Germany) from a ZLS-ceramic (Celtra® Duo, Dentsply Sirona Restorative, Germany). The restorations were milled and glazed after intraoral try-in and adjustment of contacts. Adhesive cementation was performed in the total-etch technique with one of two dual-curing composite materials. At the 12 and 24 months follow-up examinations, all restorations were in situ (survival rate: 100%). No masticatory problems or thermal sensitivity were reported. During the observational period, one clinical intervention was necessary (endodontic treatment) to maintain function. Material-induced technical complications (fractures) were not determined. The success rate (complication-free restoration) was 98.8%.

### Conclusion

Initially, chairside fabricated ZLS crowns show a good clinical performance. However, for a final evaluation of this new material, clinical data from studies with longer observational periods are required.

## Effect of Silane on the Resin Cements/Zirconia-Reinforced Lithium-Silicate Bond Strength

Kang Y, Lee H, Son H. Poster Session: International Association for Dental Research, March 25, 2017

### Objective of Study

This study evaluated the effect of silane on the bond strength of resin cements used in combination with universal adhesives to zirconia-reinforced lithium-silicate (ZLS)

### Key Finding / Analysis

Forty 12mm x 14mm x 5mm ZLS (Celtra Duo, Dentsply Sirona, shade A3 LT) were fabricated. The specimens were embedded into acrylic resin. The surface of the specimens was etched (5% HF, 30s). The specimens were randomly divided into 4 groups (n=10/gp); Group A, Single bond universal (SBU, 3M™ ESPE™); Group B, Silane (S, Porcelain primer, Bisco®) and SBU; Group C, All-bond universal (ABU, Bisco); Group D, S and ABU. A pre-cured composite-resin cylinder with a diameter of 0.8mm was bonded to treated ZLS using dual-cure resin cement [Group A, B: RelyX™ Ultimate (3M ESPE); Group C, D: Duo-Link Universal™ (Bisco)]. The specimens were stored (37°C water, 24h) and subjected to μSBS test. The data were statistically analyzed (ANOVA, Tukey's, $p<0.05$). Group B (22.48±3.98MPa) showed a significantly higher bond strength than Group A (17.47±3.54MPa). Group D (23.08±5.10MPa) showed a significantly higher bond strength than Group C (17.13±4.37MPa) ($p<0.05$).

### Conclusion

1. The silane contained in SBU was not effective in optimizing the resin cement/ZLS bond than separate silane. 2. The silane treatment prior to applying the universal adhesive significantly improved the bond strength between resin cement and ZLS.

## Long-term Aging Affects Resin Bond Strength to Zirconia-Reinforced Lithium Silicate

Boemicke W, Rammelsberg P, Pfefferkom F, Rues S. Poster Session: International Association for Dental Research, March 25, 2017.

### Objective of Study

To evaluate the effect of aging conditions and resin cement type on the bond strength to zirconia-reinforced lithium silicate (ZLS) ceramic in vitro.

### Key Finding / Analysis

ANOVA revealed bond strength was statistically significantly affected only by the aging conditions ($F=65.99$; $p<0.001$). Both cements exhibited statistically significant ($p<0.001$) lower mean bond strength values after long-term (<10MPa) than after short (~30MPa) and medium-term (~20MPa) aging. Lower mean bond strength after medium than after short-term aging was detected for specimens bonded with the amine-free resin cement ($p=0.03$), whereas there was no difference when the self-adhesive cement was used ($p=0.40$). For both cements, the percentage of an adhesive failure increased with the prolonged aging.

### Conclusion

Short- and medium-term bond strength data were of limited significance with regard to the long-term performance of the adhesives.

## Surface evaluation of a new high strength chairside CAD/CAM material

Fasbinder DJ, Neiva GF, Valcanaia A. Oral Session: School of Dentistry. University of Michigan, Ann Arbor, Michigan, United States.

### Objective of Study

A new high strength chairside CAD/CAM material has been introduced that does not require crystallization or oven-firing to fabricate a high strength restoration. This affords the opportunity for hand polishing prior to delivery. The surface smoothness of the new high strength chairside CAD/CAM material, fully-crystallized lithium aluminosilicate ceramic reinforced with lithium disilicate (N = NICE/Straumann®) was compared to fully crystallized zirconia reinforced lithium silicate (CD = Celtra® Duo/ Dentsply Sirona) and precrystallized lithium disilicate (E = IPS e.max® CAD/Ivoclar) following hand polishing.

### Key Finding / Analysis

The ANOVA found no significant interaction between material and polishing technique. There was no significant difference in the baseline surface roughness for the three materials following milling. The linear regression results indicated that the diamond-impregnated polishers specific for lithium disilicate created a statistically significantly smoother surface than the spiral polishers but not significantly different than the brush/paste technique with three different polishers rated smoother than a diamond-impregnated rubber wheel.

### Conclusion

All of the high strength materials were able to be hand polished to a high level surface smoothness.

## Retention of e.max and Celtra Duo Copings with Resin Cement

Robles AA, Nejat A, Beck P, et. al. Poster Session: Restorative Sciences, University of Alabama at Birmingham, Birmingham, Alabama, United States; School of Dentistry, Prosthodontics and Dental Biomaterials

### Objective of Study

To evaluate the effect of light curing an adhesive on tooth structure prior to the use of resin cement on the retention of e.max and Celtra Duo copings.

### Key Finding / Analysis

40 sound premolars were collected and prepared using a standard cutting machine (lathe with water spray) to obtain a 22 degree taper and 4 mm of height. Preparations were scanned and crowns were designed with 2 handles used for debonding (CEREC® 3). Crowns were milled from Celtra Duo LT A3 (n=20; G1 and G2) or e.max CAD HT A3 (n=20; G3 and G4). Prior to bonding, crowns were etched with 5% HF for 20s, rinsed and ultrasonically cleaned. Silane was applied for 60s and dried and an experimental adhesive applied. For half of the specimens (G1 and G3), the adhesive was light cured for 20s using an LED curing light (output >100mW/cm2). Crowns were filled with an experimental dual cured resin cement and seated under a 2500g load for 6 min. In G2 and G4, crowns were light cured for 20s on occlusal, buccal, and lingual surfaces. Specimens were thermocycled for 10,000 cycles (5-55°C, 15s dwell time). Crown retention force was measured using a universal testing machine and testing with a crosshead speed of 1mm/min. Crown retention strength (maximum load/area of preparation) was analyzed using 2-way ANOVA for factors ceramic material and curing mode ($\alpha$ =0.05).

### Conclusion

Light curing the adhesive under the resin cement when cementing Celtra Duo crowns produced significantly greater retention strength. Strength values were (mean±SD): 7.59±3.09 (G1), 3.65±0.89 (G2), 5.28±1.89 (G3), and 4.07±1.77 (G4). Factors curing mode and the material/curing mode interaction were significant ($p<.01$). Curing the adhesive produced a significantly greater strength when using Celtra Duo crowns but not e.max crowns.

## Chairside CAD/CAM materials. Part 2: Flexural strength testing

Wendler M, Belli R, et al., *Dent Mater*. 2017 Jan;33(1):99-109. doi: 10.1016/j.dental.2016.10.008. Epub 2016 Nov 21.

### Objective of Study

Small dimensions of CAD/CAM blocks limit reliable measurements with standardized uniaxial bending tests. The objective of this study was to introduce the ball-on-three-ball (B3B) biaxial strength test for dental, for small CAD/CAM blocks in the context of the size effect on strength predicted by the Weibull theory.

### Key Finding / Analysis

During preparation of specimens for this study, a whole set of specimens sectioned using a diamond saw were discarded due to macroscopic cracks running from the edges to the interior of the discs/plates. This was observed for VITA Suprinity® and the partially-crystallized e.max CAD blocks, but to a lesser extent. The problem was not observed for Celtra Duo (ZLS). In addition, biaxial strength of Celtra Duo (ZLS) was above 600 MPa (similar to e.max CAD). However, Celtra Duo (ZLS)'s strength is attained in its "just polished" state, whereas e.max CAD's strength is attained only after firing.

### Conclusion

Damage induced to the fragile glassy blocks by diamond-coated grinding instruments during machining is a source of concern for e.max CAD and Suprinity. However, macroscopic cracks were not observed for Celtra Duo (ZLS). Also, Celtra Duo (ZLS) does not require firing to achieve biaxial strength above 600 MPa, whereas e.max CAD does.

## Wear, strength, modulus and hardness of CAD/CAM restorative materials

Lawson NC, Bansal R, Burgess JO. *Dent Mater.* 2016 Nov;32(11):e275-e283. doi: 10.1016/j.dental.2016.08.222. Epub 2016 Sep 14.

### Objective of Study

Measure the mechanical properties of several CAD/CAM materials.

### Key Finding / Analysis

Properties were different for each material ($p<0.01$). In general, e.max® CAD and Celtra® Duo (ZLS) were stronger, stiffer, and harder than the other materials. e.max CAD, Celtra Duo (ZLS), Enamic®, and enamel demonstrated signs of abrasive wear, whereas CERASMART™, Lava™ Ultimate, and Paradigm™ MZ100 all demonstrated signs of fatigue.

### Conclusion

Overall, the "hybrid" materials (CERASMART, Lava Ultimate, Paradigm MZ100, and Enamic) had a lower flexural strength than the glass ceramics [e.max CAD and Celtra Duo (ZLS)]; the resin composites had a lower elastic modulus and hardness than the infiltrated ceramic, which in turn had a lower elastic modulus and hardness than the glass ceramics.

## Fracture toughness of chairside CAD/CAM materials— Alternative loading approach for compact tension test

R Badawy, O El-Mowafy, LE Tam, *Dent Mater.* 2016 Jul;32(7):847-52. doi: 10.1016/j.dental.2016.03.003. Epub 2016 Apr 28.

### Objective of Study

Determine plane-strain fracture toughness ($K_{IC}$) of five different chairside CAD/CAM materials used for crown fabrication, following alternative innovative loading approach of compact test specimens.

### Key Finding / Analysis

Highest $K_{IC}$ values were recorded for fired/crystallized glass-ceramic materials [Celtra Duo (ZLS)/e.max, respectively] and glass-ceramic materials without firing or crystallization were associated with significantly lower mean $K_{IC}$ compared to their fired/crystallized counterparts.

### Conclusion

Celtra Duo (ZLS) was tested in both fired and unfired conditions to determine the effect of firing on $K_{IC}$. The significantly higher $K_{IC}$ values ($p < 0.01$) recorded for fired Celtra Duo (ZLS) compared to non-fired specimens and may be due to crack-healing processes that may have occurred to existing surface microcracks after heat application.

## Stability of endodontically treated teeth with differently invasive restorations: Adhesive vs. non-adhesive cusp stabilization

R Frankenberger, I Zeilinger, M Krech, et al., *Dent Mater.* 2015 Nov;31(11):1312-20. doi: 10.1016/j.dental.2015.08.160. Epub 2015 Sep 26.

### Objective of Study

Evaluate fracture strength of endodontically treated molars with different preparations/restorations after the thermomechanical loading in vitro.

### Key Finding / Analysis

For MOD preparations, statistically higher fracture strengths were recorded for all groups except IPS Empress® CAD ($p > 0.05$). The results of partial crowns made of e.max CAD, Celtra Duo (ZLS), Lava Ultimate, and Enamic showed fracture strengths being almost comparable to the control teeth without restoration and comparable to each other ($p > 0.05$).

### Conclusion

Within the limits of this in vitro approach, it can be concluded that cuspal coverage is generally desirable for the restoration of endodontically treated teeth beyond a certain cavity extension. Newer polymer and ceramic materials as partial crowns outperformed older ceramics, such as IPS Empress.

## Adhesive luting of new CAD/CAM materials

R Frankenberger, VE Hartmann, M Krech, et al., *Int J Comput Dent.* 2015;18(1):9-20. English, German.

### Objective of Study

Evaluate the adhesive bonding performance of recently introduced tooth-colored CAD/CAM materials after different pretreatment protocols and using different luting materials.

### Key Finding / Analysis

Despite the differences found, all materials showed a high level of bonding performance, being sufficient to withstand intraoral chewing forces during mastication. However, for Calibra®, statistical subgroups of best performing groups were Celtra Duo (ZLS) > e.max CAD > Enamic > Lava Ultimate ($P < 0.05$), and for RelyX™ Unicem, statistical subgroups of best performing groups were Celtra Duo (ZLS) = e.max CAD > Enamic > Lava Ultimate ($P < 0.05$).

### Conclusion

Under application of the recommended pretreatment protocols, the novel CAD/CAM materials show promising, bonding performances to different types of luting resin composites.

## Translucency of esthetic dental restorative CAD/CAM materials and composite resins with respect to thickness and surface roughness

D Awad, B Stawarczyk, A Liebermann, et al., *J Prosthet Dent.* 2015 Jun;113(6):534-40. doi: 10.1016/j.prosdent.2014.12.003. Epub 2015 Mar 4.

### Objective of Study

Evaluate the translucency of restorative CAD/CAM materials and direct composite resins with respect to thickness and surface roughness.

### Key Finding / Analysis

The effect of all tested parameters was significant among the tried materials (P < .05): Celtra® Duo (ZLS), IPS e.max®, IPS Empress®, Lava™ Ultimate, Telio CAD, VITA CAD Temp®, VITA Enamic®, VITA Mark II®, TEC® BulkFill, TEC® A2, and Filtek™ Supreme XTE. The greatest influence on the measured translucency was thickness (partial eta squared ηP2 = .988), closely followed by material (.982), and the pretreatment method (.835). The surface roughness was strongly influenced by the pretreatment method (.975) and type of material (.941).

### Conclusion

Celtra Duo (ZLS) is a new class of ceramic, which is called zirconia-reinforced lithium silicate. The inclusion of 10% zirconia dissolved into the lithium silicate glass matrix results in 4 times smaller silicate crystals, implying a high glass content and higher translucency than conventional LiSi2 ceramics [Celtra Duo (ZLS); DeguDent GmbH]. In fact, Celtra Duo (ZLS) attained higher T% values than IPS e.max CAD, but only in the case of a polished surface.

## Microtensile Bond Strength of Lithium Disilicate Ceramics to Resin Adhesives

MN Aboushelib, D Sleen, *J Adhes Dent.* 2014 Dec;16(6):547-52. doi: 10.3290/j.jad.a33249.

### Objective of Study

Evaluate the influence of the internal structure of lithium disilicate glass ceramics (LDC) on the microtensile bond strength to a resin adhesive using two surface treatments.

### Key Finding / Analysis

Statistical analysis revealed significant differences in microtensile bond strength values between different LDCs ($F = 67$, $p < 0.001$), different surface treatments ($F = 232$, $p < 0.001$), and interaction between LDC and surface treatments ($F = 67$, $p < 0.001$). Specifically, microtensile bond strength of Celtra Duo (ZLS) ceramic (30.4 ± 4.6 MPa) was significantly higher than both IPS Empress® 2 (21.5 ± 5.9 MPa) and IPS e.max ceramics (25.7 ± 4.8 MPa), which had almost comparable MTBS values.

### Conclusion

Within the limitations of this study, bond strength to lithium disilicate ceramics depends on proper surface treatment and on the chemical composition of the glass ceramic.

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