4. CERAMILL ZI (GOEL)

Our Ceramill ZI zirconia performed extremely well in an independent study by the University of Zürich, Switzerland, that was presented last weekend at the Dental Materials Conference in Trieste, Italy. The flexural strength of our blanks is the highest in the partially sintered blank milling sector with 1195 MPa.

Groups	Final sintering temperature	3-point flexural strength (SD) (N)	Weibull-modulus (95% CI)
DC Zircon (control)	–	1643 (64)[a]	10.1 (6.6, 15.6)
ZENO ZR	1450	913 (52)[b,c,d]	5.7 (3.7, 8.7)
DD BioZWiso	1550	821 (29)[d]	9.6 (6.3, 14.6)
GC ZR Disc CIP	1550	818 (45)[d]	8.3 (5.5, 12.6)
Ceramill Zi	1450	1195 (58)[b]	5.6 (3.8, 8.2)
Copran	1450	1124 (62)[b,c]	5.9 (3.8, 8.9)
InCoris ZI	1530	963 (37)[b,c,d]	8.8 (5.8, 13.3)
InCeram YZ	1530	1106 (40)[b,c]	7.4 (5.1,10.8)
Cercon ZR	1350	868 (43)[c,d]	6.6 (4.3, 10.0)
LAVA Zirkon	1500	939 (32)[b,c,d]	7.7 (5.3, 11.2)

[a,b,c,d] Values followed by the same letter are statistically similar ($p > 0.05$).

[1] DC Zircon, DCS.
[2] ZENO ZR, Wieland Dental.
[3] DD BioZWiso, Dental Direkt.
[4] GC ZR Disc CIP, GC Europe.
[5] Ceramill Zi, Armann Girrbach.
[6] Copran, White Peak.
[7] InCoris ZI, Sirona.
[8] InCeram YZ, Vita Zahnfabrik.
[9] Cercon ZR, DeguDent.
[10] LAVA Zirkon, 3M ESPE.

The conclusion of the study is: Zircon oxides, which are sintered at sinter temperatures higher than 1,540 °C, exhibit significantly lower flexural strengths than zircon oxides sintered at lower temperatures.

Hot isostatically pressed zircon oxide (in this case DC Zircon, DCS Dental AG, Switzerland) has the highest flexural strength and Weibull modulus – but is uneconomical to process.

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Effect of sintering and SiO_2 deposition on core–veneer ceramic bonding

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Objectives: To test the hypotheses that the bond strength between zirconia core and veneer is influenced by multiple sintering of the veneering ceramic and by SiO_2 film deposition.

Materials and methods: Zirconia-based ceramic blocks (YZ) were polished and randomly divided into 4 groups according to the veneer ceramic sintering protocol and to the presence of SiO_2 film on the YZ surface: G1 – two sintering procedures; G2 – three sintering; G3 – two sintering procedures + film deposition; and G4 – three sintering + film deposition. SiO_2 films were deposited on the YZ surface using plasma method (physical vapor deposition-PVD) with reactive magnetron sputtering technique, prior to the veneer application and EDS analysis was performed to determine the elements present on the zirconia surface after silica deposition. The blocks were sectioned in order to obtain bars with 1 mm^2 of cross-sectioning area. The bars were fixed to a universal test machine device and microtensile bond strength test (μTBS) was performed. Specimens' fracture surfaces were analyzed under optical microscopy (Stemi 2000-C, Carl Zeiss) in order to characterize the failure mode. The thickness of the silica film was estimated on zirconia fractured samples using the EDS scan line technique. Data were analyzed using ANOVA (2-way), Tukey's post hoc test ($\alpha = 0.05$). The Weibull modulus was calculated.

Results: The mean values of μTBS (MPa) for the groups were: G1 (15 ± 6.6); G2 (18 ± 6.7); G3 (13.8 ± 2.2); G4 (17.7 ± 4.8). The number of veneer ceramic sintering procedures affected significantly the core–veneer bond strength ($p < 0.05$). The bond strength values were not affected by the SiO_2 film ($p > 0.05$). G3 showed the highest Weibull modulus (7), followed by G4 (4), G2 (3), and G1 (2). The analyses of fracture surface revealed the failure was originated on the core–veneer interface and run through the veneer porcelain for the most part of the specimens in group G1 and G2, and for all the G3 and G4 specimens. The film thickness was estimated in 0.5 μm and EDS surface analysis showed a homogeneous Si deposition in the Y-TZP surfaces.

Conclusions: The number of the veneer ceramic sintering procedures affects the core–veneer bond strength of the bilayer ceramic system tested in this study. SiO_2 film deposition, using PVD method, decreases the probability of failure of the system.

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Effect of sintering temperature on three-point flexural strength of different zirconia materials

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Objectives: This study tested the 3-point flexural strength of zirconia materials with different sintering temperatures.

Materials and methods: Three-point flexural strength of one hipped zirconia[1] (control group) and 9 different zirconia materials in white state[2,3,4,5,6,7,8,9,10] ($N = 150$, $n = 15$ per group) was measured according to ISO 6872: 1995 (1.2 mm × 4 mm × 25 mm). Before sintering, the specimens of the white state zirconia materials were ground and finished to the final dimensions using silicone carbide discs of 220, 500 and 1200 in sequence. Thereafter, all specimens of white state zirconia materials were sintered in the sintering oven (LHT 02/16, Nabertherm) according to each manufacturer's instructions. The dimensions of the specimens were measured at an accuracy of 0.01 mm. The specimens were placed in their respective jigs and loaded in the Universal Testing Machine (Z010, Zwick, 1 mm/min) until failure. Data were analyzed using descriptive statistics (95% CI), one-way ANOVA, followed by post hoc Scheffé test (alpha = 0.05). In addition, Weibull moduli were calculated.

Results:

Groups	Final sintering temperature	3-point flexural strength (SD) (N)	Weibull-modulus (95% CI)
DC Zircon (control)	–	1643 (64)[a]	10.1 (6.6, 15.6)
ZENO ZR	1450	913 (52)[b,c,d]	5.7 (3.7, 8.7)
DD BioZWiso	1550	821 (29)[d]	9.6 (6.3, 14.6)
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LAVA Zirkon	1500	939 (32)[b,c,d]	7.7 (5.3, 11.2)

[a,b,c,d] Values followed by the same letter are statistically similar ($p > 0.05$).

Conclusions: Sintering temperature exceeding 1540 °C resulted in significantly lower 3-point flexural strength compared to those of the zirconia materials sintered at lower temperatures. Hipped zirconia exhibited the highest 3-point flexural strength and the Weibull-modulus.

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[1] DC Zircon, DCS.
[2] ZENO ZR, Wieland Dental.
[3] DD BioZWiso, Dental Direkt.
[4] GC ZR Disc CIP, GC Europe.
[5] Ceramill Zi, Armann Girrbach.
[6] Copran, White Peak.
[7] InCoris ZI, Sirona.
[8] InCeram YZ, Vita Zahnfabrik.
[9] Cercon ZR, DeguDent.
[10] LAVA Zirkon, 3M ESPE.