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Is it necessary to photoactivate bonding agents inside ceramic crowns?

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Purpose/aim: The aim of this study was to analyze the effect of the application and previous photoactivation of different adhesive systems on lithium dissilicate ceramics, with emphasis on the bond strength of cement-ceramic interface and the analysis of the mechanical properties (nanohardness and elastic modulus) of different adhesives systems and resin cement used.

Materials and methods: Forty-nine composite resin blocks (Z350XT A6B) and ceramic tablets (e.max CAD LT D3) which were divided into seven experimental groups ($n = 7$), according to the adhesive systems and photoactivation techniques of the materials inside the ceramic crown: Group 1: control (without adhesive system); Group 2: SBMP with no light-curing; Group 3: light-cured SBMP; Group 4: SB2 with no light-curing; Group 5: light-cured SB2; Group 6: SBU with no light-curing; Group 7: light-cured SBU. After the luting procedure with RelyX Ultimate, all specimens were submitted to thermocycling procedure (10,000 cycles). Sticks were then obtained for the analysis of microtensile bonding strength and nanohardness and elastic modulus of the resin componentes of the adhesive interface. Data were submitted to statistical analysis (ANOVA) and Fisher's test ($\alpha = 0.05$).

Results: The results showed that the SBMP with no light-curing and SB2 with no light-curing groups had the lowest values of bonding strength, while the highest values of the mechanical properties were achieved for the light-cured SBMP group, showing that the bonding strength as well as the mechanical properties was influenced by the interaction of materials. For mechanical properties analyzed, the light-curing of the adhesive systems did not present a statistically significant diference in the comparison between groups. In general, the application of adhesive systems on the silanized ceramic surface showed needless.

Conclusions: Among the adhesives studied, SBU was the only system that showed effectiveness with or without previous light activation. For the other adhesive systems, SBMP and SB2, the previous light activation was necessary to optimize the bonding strength of the adhesive interface.

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Y-TZP reinforced with reduced graphene oxide: Evaluation of processing conditions

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Purpose/aim: To develop a processing method for yttrium stabilized zirconia pollycrystal (YTZP) reinforced with reduced graphene oxide (rGO) and to verify the effect of rGO concentration on hardness and fracture toughness of the material.

Materials and methods: The composite production included several steps: (a) synthesis of Y-TZP powder by coprecipitation route, (b) synthesis of graphene oxide from chemical exfoliation of graphite (modified Hummer's method) followed by reduction with ascorbic acid, (c) sonication of reduced graphene oxide in Y-TZP suspension followed by drying (d) uniaxial pressing in metal device with diameter of 5 mm and (e) sintering in a conventional tubular furnace (Argon/4%hydrogen atmosphere) or spark plasma sintering (SPS). The concentration of rGO in Y-TZP was fixed between 0.01 and 2.0 wt%. Sintered samples were characterized by X-ray diffraction, scanning electron microscopy, density measurements, and Vickers method for hardness and fracture toughness determination (indentation fracture). Data were analyzed by ANOVA and Tukey's test with global significance level of 5%.

Results: Results (Table 1) showed that the procedure stablished for dispersion of rGO in the Y-TZP resulted in good physical homogeneity of rGO and Y-TZP. Regarding the sintering procedure, it was observed that conventional sintering in a controlled atmosphere was not effective for ceramic densification due to microcrack formation at the ceramic surface. For conventional sintering, the hardness obtained for the rGO concentration of 2% was significantly lower than those obtained for all other concentrations, however, for this processing method, fracture toughness was not affected by rGO concentration. For SPS, both fracture toughness and hardness were

Table 1 – Results about concentration of rGO in Y-TZP and sintering condition (Conventional sintering – CS and Spark plasma sintering – SPS): Density Theoretical (DT%), Hardness Vickers (GPa) and fracture toughness (MPa m$^{1/2}$).

Concentration (wt%)	Sintering condition	DT (%)	Hardness Vickers (GPa)	Fracture toughness (MPa m$^{1/2}$)
0	CS	96.76	8.83 ± 0.39 a	7.16 ± 0.69 a
0	SPS	94.99	12.35 ± 0.19 a	7.16 ± 0.48 ab
0.01	SPS	98.30	12.21 ± 0.21 a	6.10 ± 0.51 b
0.05	CS	93.15	9.41 ± 0.48 a	8.33 ± 2.11 a
0.05	SPS	95.52	11.44 ± 0.16 b	7.78 ± 0.38 a
0.10	CS	89.05	8.23 ± 1.56 a	7.11 ± 0.59 a
0.50	SPS	98.73	12.10 ± 0.23 a	7.77 ± 1.17 a
2.00	CS	86.73	6.13 ± 0.69 b	7.06 ± 0.59 a

affected by rGO concentration, with the lowest hardness mean value measured for the concentration of 0.05% and the lowest fracture toughness value measured for specimens with addition of 0.01% of rGO.

Conclusions: The production of the composite Y-TZP/rGO was proved possible, and sintering via spark plasma resulted in higher mechanical properties of the composite material compared to conventional sintering. rGO concentration affected the hardness of the composite for both processing methods (conventional and SPS), however fracture toughness was only affected by rGO concentration for specimens processed via SPS.

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A network meta-analysis of different light-activation to dental bleaching

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Purpose/aim: A systematic review with a network meta-analysis were performed to answer the following research question: "Is there any light-activation protocol capable of improving color change efficacy when associated to an in-office bleaching gel in adults?"

Materials and methods: Search was performed in PubMed, Scopus, Web of Science, LILACS, BBO, Cochrane Library and SIGLE, without restrictions date and/or language in April 23 2017 (updated on March 30 2018). IADR abstracts (1990–2018), unpublished and ongoing trials registries, dissertations and theses were also searched. Only randomized clinical trials conducted in adults that included at least one group treated with in-office dental bleaching with light-activation were included. The risk of bias (RoB) was evaluated used Cochrane Collaboration tool. A random-effects Bayesian mixed treatment comparison (MTC) model was used to combine light-activated vs. light-free in-office bleaching with direct light-free comparison trials. Meta-analysis with independently analysis (high- and low-concentrate hydrogen peroxide [HP]) was conducted for color change (ΔE^*, ΔSGU).

Results: After removal of duplicates, title and abstract screening, 28 studies remained. Nine were considered to be at low RoB; five were at a high RoB, the remaining were at an unclear RoB. The MTC analysis showed no significant difference in color change (ΔE^* and ΔSGU) between light-activation protocols and light-free in-office bleaching, regardless of the HP concentration in the efficacy of the bleaching.

Conclusions: No type of light-activated in-office bleaching was superior to light-free in-office bleaching for both high- and low-concentrate in-office bleaching gels (PROSPERO–CRD42017078743).

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File-splitting multilayer vs Y-TZP: Fatigue strength and finite element analysis

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Purpose/aim: To evaluate the flexural fatigue strength of ceramic structures obtained by the file-splitting techniques (fused and cemented) with both veneer and framework under tension in comparison with monolithic Y-TZP. In addition, finite element analysis (FEA) of the ceramic systems was performed to compare the model predictions with the experimental flexural fatigue strength values.

Materials and methods: Disc-shaped (diameter: 14.4 mm; thickness: 1.4 mm) monolithic Y-TZP (IPS e.max ZirCAD–Ivoclar Vivadent) and trilayer specimens with Y-TZP framework (IPS e.max ZirCAD), intermediate layer of fusion ceramic (IPS e.max CAD Crystall./Connect) or resin cement (Multilink Automix) and lithium disilicate veneer (IPS e.max CAD) were prepared according to ISO 6872:2008 and divided into five groups ($n=20$): monolithic Y-TZP (M), fused file-splitting with framework under tension (F-FT), cemented file-splitting with framework under tension (C-FT), fused file-splitting with veneer under tension (F-VT) and cemented file-splitting with veneer under tension (C-VT). Fatigue flexural strength was determined (piston-on-three ball) by the staircase approach (750,000 cycles; 20 Hz). The first specimen of each group was tested at approximately 60% of the flexural strength determined in a previous monotonic test ($n=3$). Increments adopted were approximately 10% of the initial strength. Mean and confidence intervals (CI) were calculated. FEA maximum principal stress was evaluated under the application of the experimental mean fatigue load.

Results: The fatigue strength was statistically different for all groups. Means and CI (MPa) were: M–405.92 (CI

Table 1 – Mean values with SD.

Group	Description	Material under tension	Monotonic strength (SD)	Fatigue initial stress	Step	Fatigue strength (CI)	FEA
M	Monolithic Y-TZP	–	689.86 (18.94)	413.92	40	405.92 (CI 397.58–414.26)	403
F-FT	Fused trilayer	Y-TZP framework	575.26 (11.03)	345.15	34.5	377.73 (CI 374.59–380.88)	367
C-FT	Cemented trilayer	Y-TZP framework	525.06 (0.53)	315.04	31.5	346.54 (CI 340.62–352.46)	366
F-VT	Fused trilayer	Lithium disilicate veneer	308.64 (22.11)	185.18	18.5	154.79 (CI 151.86–157.72)	147
C-VT	Cemented trilayer	Lithium disilicate veneer	160.83 (19.42)	96.5	9.6	100.34 (CI 97.42–103.26)	106