Influence of Ambient Air and Different Surface Treatments on the Bonding Performance of a CAD/CAM Composite Block.


Authors: Ali A, Takagaki T, Nikaido T, Abdou A, Tagami J

Abstract

PURPOSE: To evaluate the bond strengths of time elapsed after sandblasting with alumina particles on a CAD/CAM composite block treated with different surface conditioning methods.

MATERIALS AND METHODS: A CAD/CAM composite block (CCB) was cut into 72 slices of approximately 2 mm thickness. The CCB slices were divided into three groups according to sandblasting pressure (0.1 MPa, 0.2 MPa, or untreated), and then divided into two subgroups according to the time elapsed after sandblasting: same-day or one-week dry storage under controlled laboratory conditions before cementation. Surface roughness was observed by confocal laser microscopy (CLSM) (n = 20); then the wettability of the CCB surfaces was examined using a contact angle (CA) measuring device on a droplet of deionized water (n = 12). Next, CCB slices were divided into three subgroups according to the surface treatment: Clearfil Ceramic Primer (CP), Clearfil Universal Bond (UB), or a mixture of Clearfil Porcelain Bond Activator and Clearfil tri-S Bond ND Quick (NDP). All CCB slices were then cemented with Panavia V5 and stored at 37°C in distilled water for 24 h and cut into sticks (n = 10). The sticks were subjected to microtensile bond strength (μTBS) testing, and failure mode analysis was performed using scanning electron microscopy. The μTBS results were subjected to 3-way and 2-way ANOVA (α = 0.05).

RESULTS: All groups showed a statistically significant increase in wettability
accompanied by decreased µTBS after one week; however, the UB group exhibited stable performance after one week. CONCLUSION: The time elapsed after sandblasting with alumina particles affects the bond strength, but it had no significant effect on the UB group.

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GPDM- and MDP-based Self-etch Adhesives Bonded to Bur-cut and Uncut Enamel - "Immediate" and "Aged" µTBS.

J Adhes Dent. 2018 Apr 19;:1-8

Authors: Hoshika S, Kameyama A, Suyama Y, De Munck J, Sano H, Van Meerbeek B

Abstract
PURPOSE: To determine the microtensile bond strength (µTBS) of two 2-step self-etch adhesives (SEAs) to bur-cut and uncut enamel.

MATERIALS AND METHODS: The buccal and lingual enamel surfaces of 15 teeth were ground flat ("bur-cut" enamel), while the enamel surface of another set of 15 teeth was solely prophylactically cleaned ("uncut" enamel). Resin composite was bonded to the surfaces using the GPDM-based SEA OptiBond XTR (Kerr), the 10-MDP-based SEA Clearfil SE Bond (Kuraray Noritake), or the 3-step etch-and-rinse adhesive (E&RA) OptiBond FL (Kerr) that served as the gold-standard control.
After 1-week water storage at 37°C, specimens were serially cut into 1-mm² stick-shaped microspecimens, of which half per tooth were further subjected to 20,000 thermocycles (TC) prior to μTBS testing. Data were statistically analyzed using ANOVA and the post-hoc Tukey test. The interfacial ultrastructure of the GPDM-based SEA OptiBond XTR with uncut and bur-cut enamel was additionally characterized with transmission electron microscopy (TEM).

RESULTS: After 1-week water storage and upon TC aging, both SEAs bonded significantly (p < 0.05) less effectively to both bur-cut and uncut enamel than did the control OptiBond FL, except when OptiBond XTR was bonded to burcut enamel; then a similarly high μTBS was recorded (p > 0.05). TEM interfacial characterization revealed a tight interaction of Optibond XTR with both bur-cut and uncut enamel.

CONCLUSION: The best bonding efficacy to enamel is still achieved by etching with phosphoric acid, following an E&R approach, while the higher etching efficacy of the GPDM-based SEA may result in equally effective bonding, provided that the enamel is bur-roughened first.

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(NL) of several universal adhesives to eroded dentin (ED), using etch-and-rinse (ER) or self-etch (SE) strategies, and to characterize the surface using two pH cycling models to erode dentin (citric acid and a soft drink).

MATERIALS AND METHODS: Molars were eroded either by soft-drink or citric acid cycling, or were left untreated as control (SD). For each surface, the following adhesives were applied: 1. All-Bond Universal; 2. Ambar Universal; 3. Clearfil Universal; 4. Futurabond U; 5. One Coat 7 Universal; 6. Peak Universal Bond; 7. Prime&Bond Elect; 8. Scotchbond Universal; 9. Tetric n-bond Universal, and 10. Xeno Select. After application of the composite, specimens were sectioned into composite-dentin sticks and tested under tension (0.5 mm/min). Selected sticks from each tooth were used to assess NL. The occlusal dentin surfaces after erosive cycling were examined using SEM. Data were analyzed by three-way ANOVA and Tukey’s post-hoc test (a = 0.05).

RESULTS: In ED, there was no difference in μTBS and NL between ER and SE strategies (p > 0.61). Most μTBS and NL values obtained for ED were, respectively, lower and higher than those for SD (p < 0.01), being worse for citric acid ED (p < 0.001). Citric-acid-eroded dentin showed more enlarged tubules, with partial loss of peritubular dentin when compared to soft-drink eroded dentin.

CONCLUSION: The different pH cycling models reduced μTBS and increased NL of the composite/eroded-dentin interface; however, in ED, the performance of the universal adhesives did not depend on the adhesive strategy used.

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Effect of Calcium Hydroxide on Bonding Performance of an Experimental Self-etch Adhesive.
Self-etch Adhesive.

J Adhes Dent. 2018 Feb 16;:1-8

Authors: Garcia MG, Poskus LT, Hass V, Amaral CM, Noronha-Filho JD, Silva EMD

Abstract

PURPOSE: To investigate the effect of Ca(OH)2 concentration on pH neutralization, degree of conversion (DC%), and bonding performance of experimental self-etch adhesives (SEAs).

MATERIALS AND METHODS: Four different concentrations of Ca(OH)2 (0 wt%, 1 wt%, 2 wt%, and 4 wt%) were added to the bond of an experimental two-step SEA consisting of primer (10-MDP [30 wt%], TEG-DMA [30 wt%], ethanol [35 wt%], water [5 wt%], camphorquinone [0.5 wt%], and tertiary amine [0.5 wt%]) and bond (bis-GMA [50 wt%], TEG-DMA [30 wt%], HEMA [20 wt%], camphorquinone [0.5 wt%], and tertiary amine [0.5 wt%]) to form four groups: E0, E1, E2 and E4. pH neutralization was evaluated until it reached equilibrium, and DC% within the hybrid layer was analyzed by micro-Raman spectroscopy. Human molars were wet ground until the occlusal dentin was exposed, SEAs were applied, and composite buildups were constructed. After storage in distilled water at 37°C for 24 h, the teeth were cut into composite-dentin beams. Microtensile bond strength (μTBS) was evaluated after 24 h of water storage at 37°C. Nanoleakage was evaluated by SEM. Data were analyzed using ANOVA and Tukey’s HSD test (a = 0.05).

RESULTS: All the SEAs reached pH equilibrium after thirteen days, with E1 and E4 presenting the highest pH (p < 0.05). E0 and E1 presented lower DC% than did E2 and E4 (p < 0.05). All the SEAs showed statistically similar mTBS and nanoleakage (p > 0.05).

CONCLUSION: The incorporation of Ca(OH)2 endowed the SEAs with pH-neutralization ability and improved their DC%, without interfering with the bond strength to dentin or nanoleakage extent.

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Effect of Veneering Techniques on Shear and Microtensile Bond Strengths of Zirconia-Based All-Ceramic Systems.

J Adhes Dent. 2017 Dec 18;;507-515

Authors: Yilmaz Savas T, Aykent F

Abstract

PURPOSE: To evaluate shear (SBS) and microtensile (μTBS) bond strengths of zirconia cores veneered using different fabrication techniques.

MATERIALS AND METHODS: Seventy-five IPS e.max ZirCAD plates were fabricated and divided into three groups according to the following veneering techniques: layering, pressing, and CAD-on. The specimens of the layering group were veneered with IPS e.max Ceram, and the specimens of the pressing group were veneered with IPS e.max Zir- Press. Veneering ceramics in the CAD-on group were milled from IPS e.max CAD, fused with the core by using a glass-fusion ceramic, and then crystallized. Bond strength tests were performed using a universal testing machine at a crosshead speed of 0.5 mm/min for the SBS test and 1 mm/min for the μTBS test. Mean SBS and μTBS (MPa) were analyzed with one-way ANOVA and Tukey’s HSD test (p < 0.05).

RESULTS: Significant differences in SBS were observed between the groups (p < 0.05). The mean SBS for the CAD-on group was significantly higher (31.89 ± 5.83 MPa) than those of the layering (14.27 ± 4.45 MPa) and pressing (12.23 ± 3.04 MPa) groups. However, the mean μTBS of the CAD-on (30.41 ± 8.64 MPa), layering (21.71 ± 3.40 MPa) and pressing (20.74 ± 6.36 MPa) groups were not statistically significant (p > 0.05).

CONCLUSION: The CAD-on technique showed the highest shear bond strengths of the tested groups, and most of the specimens failed cohesively instead of failing.
Immediate and 6-month Bond Strengths of Different Adhesives in the Oral Environment.

J Adhes Dent. 2017 Dec 18;:475-481


Abstract
PURPOSE: To evaluate the microtensile bond strength (μTBS) of three adhesives to dentin after 1 week and 6 months in an oral environment.

MATERIALS AND METHODS: Class I cavities were prepared in the third molars of 30 patients and randomized into 3 groups according to the following adhesives: Scotchbond Multi-Purpose (SM), Clearfil Protect Bond (CF), and Scotchbond Universal (UN). These molars were then subdivided into two groups according to the exposure time in the oral environment: one week (1W) and 6 months (6M). After the exposure time, the teeth were extracted, cut into beams, and submitted to the μTBS test. The data were analyzed using the Shapiro-Wilk test and two-way ANOVA followed by Tukey’s post-hoc test with a significance level of 5%, and fracture modes were analyzed.

RESULTS: The bond strengths in MPa (mean ± SD) were SM-1W: 39.5 ± 7.9; SM-6M: 29.7 ± 1.8; CF-1W: 30.5 ± 1.4; CF-6M: 28.6 ± 4.1; UN-1W: 30.6 ± 3.2;
and UN-6M: 26.7 ± 2.0. The SM-1W group exhibited significantly increased μTBS compared with the other groups. After 6 months in the oral environment, a significant reduction of μTBS was only observed for the SM group, whereas similar bond strengths were observed for the other groups. SM-1W exhibited a predominance of mixed fractures, whereas the other groups showed a predominance of adhesive fractures.

CONCLUSIONS: The adhesives which were applied in the self-etching mode maintained bond strength after six months in the oral environment. A reduction of μTBS was only observed for the three-step etch-and-rinse adhesive.

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Dentin μTBS and Hardness of Bulk-fill and Conventional Composites Placed in a Box-shaped Cavity Preparation.

J Adhes Dent. 2017 Nov 17;;1-6

Authors: Silame FDJ, Geraldeli GP, Sinhoreti MAC, Pires-de-Souza FCP, Roulet JF, Geraldeli S

Abstract

PURPOSE: To compare the dentin microtensile bond strength (μTBS) and the Knoop hardness of bulk-fill and conventional restorative composites in box-shaped Class I cavities using different insertion techniques.
MATERIALS AND METHODS: Forty box-shaped Class I preparations 4 mm deep were performed in the pulp chamber of sound human third molars. The restorations were made using either a conventional microhybrid (Z250, 3M ESPE) or bulk-fill (Tetric EvoCeram Bulk-fill, TCBF) composite using two incremental thicknesses: 2 mm or 4 mm (n = 10). After 24-h water storage, the restorations were sectioned. The first slice (0.7 mm thick) taken from a proximal surface was submitted to the Knoop hardness (KHN) test at five depths from the occlusal cavosurface to the pulpal line angle. Sticks were fabricated from the remaining sections and tested for dentin microtensile bond strength (μTBS). Means were analyzed using two-way ANOVA and Tukey’s test (p < 0.05).

RESULTS: Higher (p < 0.05) μTBS resulted when both composites were restored with 2-mm increments, with no significant difference between materials (p > 0.05). Higher (p < 0.05) KHN means were found when 2-mm increments were used, with no significant differences (p > 0.05) between the materials. When the teeth were restored with one bulk increment (4 mm), the deeper layers presented lower KHN means (p < 0.05) starting at 2 mm for Z250 and 3 mm for TCBF.

CONCLUSION: The 2-mm increment restorations in box-shaped cavities yielded higher μTBS and microhardness for conventional and bulk-fill composites.

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Abstract

PURPOSE: To study the influence of a polyalkenoate copolymer (VCP) on the immediate (24 h) and 6-month dentin bonding stability of VCP-based adhesives, using microtensile bond strength (μTBS), nanoleakage (NL), and ultramorphological analyses (FE-SEM).

MATERIALS AND METHODS: Eighty-four caries-free molars were randomly assigned to seven adhesives: Clearfil SE Bond (CSE, Kuraray Noritake); Adper Single Bond Plus (SB, 3M ESPE); SB without VCP (SBnoVCP, 3M ESPE); Scotchbond Universal Adhesive applied as a etch-and-rinse adhesive (SBU_ER); SBU without VCP applied as an etch-and-rinse adhesive (SBUnoVCP_ER); SBU applied as a self-etch adhesive (SBU_SE, 3M ESPE); SBU without VCP applied as a self-etch adhesive (SBUnoVCP_SE, 3M ESPE). Half of the beams were tested after 24 h, and the other half was aged in water for 6 months prior to testing. For each tooth/evaluation time, two beams were randomly selected for NL analysis. Statistical analyses of μTBS results were performed using two-way ANOVA, Tukey’s post-hoc tests, and Student’s t-test for paired data (α = 0.05). Nanoleakage was statistically analyzed using the Kruskal-Wallis and Mann-Whitney tests, with Wilcoxon’s test for paired data. For FE-SEM, four caries-free molars were assigned to each of the seven groups. Dentin disks were restored and cross sectioned into halves. One half was observed at 24 h, and the other at 6 months.

RESULTS: The highest 6-month mean μTBS was obtained with SBU_SE/SBUnoVCP_SE and SBUnoVCP_ER. SBUnoVCP_SE resulted in greater silver deposition at 6 months. FE-SEM observations showed that CSE and SBU_SE specimens resulted in a submicron hybrid layer without signs of degradation at 6 months.

CONCLUSIONS: VCP may contribute to the long-term bonding stability of VCP-based adhesives.

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Bonding Behaviour of Polyetherketoneketone to Methylmethacrylate- and Dimethacrylate-based Polymers.

J Adhes Dent. 2017 Aug 28;;1-8

Authors: Stawarczyk B, Silla M, Roos M, Eichberger M, Lümkemann N

Abstract

PURPOSE: To investigate the impact of pretreatment and conditioning on bonding behavior of polyetherketoneketone (PEKK) to methylmethacrylate(MMA)- and dimethacrylate(DMA)-based polymers.

MATERIALS AND METHODS: 1200 PEKK substrates (Pekkton ivory) were fabricated, air abraded (110 μm, Al2O3) and divided into 8 pretreatment groups as follows: 1. Visio.link (VL); 2. VL+ opaquer; 3. Pekk Bond (PB); 4. PB + opaquer; 5. plasma; 6. plasma + opaquer; 7. plasma + VL+ opaquer; 8. plasma + PB + opaquer. A low-density cold oxygen plasma was used to treat specimens in groups 5-8. All pretreated PEKK substrates were bonded with either MMA-based polymers (denture acrylic: “Anaxdent acryline”) or DMA-based polymers (veneering composites: flowable “Anaxdent dentin flow” or packable “Anaxdent dentin paste”). On denture acrylic, the anaxgum opaquer paste was applied, and on veneering composites, the anaxblend opaquer paste. All specimens were stored in water for 24 h at 37°C, and 20 specimens of each subgroup were additionally thermocycled (5°C/55°C, 10,000x). Tensile bond strength (TBS) was measured and analyzed with the general linear model analysis, Kaplan-Meier survival estimates, and Breslow-Gehan tests.

RESULTS: The combination of plasma and VL showed the highest TBS results, followed by VL and the combination of plasma and PB. The lowest TBS was observed among PEKK specimens treated with plasma and without pretreatment, followed by specimens conditioned with PB. The application of an opaquer layer
increased the TBS. Bonding to PEKK with MMA-based polymers showed higher TBS results than with DMA-based polymers. Among DMA-based polymers, the flowable polymer bonded significantly better to PEKK compared to paste polymer. After thermocycling, the TBS decreased.

CONCLUSION: Sufficient bonding to PEKK is possible when plasma treatment is used in combination with the tested adhesives and an opaquer layer.

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Efficacy of Different Surface Treatments for Intraoral Repair of Veneered Zirconia Frameworks.

Efficacy of Different Surface Treatments for Intraoral Repair of Veneered Zirconia Frameworks.

J Adhes Dent. 2017 Aug 28;:1-7

Authors: Libecki W, Elsayed A, Lehmann F, Kern M

Abstract

PURPOSE: To evaluate the efficacy of different surface treatments on the repair of veneered zirconia ceramics.

MATERIALS AND METHODS: Forty-eight zirconia disks were divided into three groups according to the method of surface treatment: polished surface, air abraded, or ground using a special silicon carbide bur (SiC Grinding Bur). All specimens were primed using a primer containing MDP (Cimara Zircon, Voco) and then bonded to composite in Plexiglas tubes using dual-curing adhesive resin (Bifix QM, Voco). Each of the three groups was further divided into two subgroups (n = 8) stored either in water at 37°C for 3 days without thermocycling or stored in water at 37°C for 150 days with an additional 37,500 thermocycles between
5°C and 55°C. After storage, tensile bond strength (TBS) was measured in a universal testing machine.

RESULTS: After 3 days of storage, silicon carbide bur and air-abraded groups showed high TBS that ranged from 32.7 to 41.0 MPa (p ≤ 0.05). After 150 days of storage with thermocycling, the air-abraded group showed the most durable TBS (34.8 MPa), while the silicon carbide bur group showed a significant reduction in TBS (21.2 MPa); in the polished control group, specimens all debonded spontaneously during storage (p ≤ 0.05).

CONCLUSION: Repair of zirconia ceramic after chipping of its veneers showed durable TBS when surface conditioning with air abrasion or roughening of the zirconia surface with a silicon carbide bur was provided.

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