Friday, March 5, 2010

818

Wear Resistance of SureFil SDR Flow Posterior Flowable Base

Location: Exhibit Hall D (Walter E. Washington Convention Center)
Q. DAI, and S. BERTRAND, Dentsply Caulk, Milford, DE

OBJECTIVE: To determine the wear resistance of Dentsply SureFil SDR Flow Posterior Bulk Fill Flowable Base restorative and compare to other universal / posterior / flowable restoratives.

METHODS: The Leinfelder Wear machine was used to simulate two-body wear. The stresses were transferred to a composite specimen by means of a stainless steel conical stylus in the presence of water only. The stylus was under 50N load at 0.5Hz for 200,000 cycles. Surfaces of the specimens were 3D profiled to allow determination of volume loss and maximum depth after wear. The abrasion resistance was tested by running a standard prophylaxis using the prophy as the abrading substance. The specimen was tested under 500 gram load for 8 minutes. The volume loss was determined by weight loss and density of the specimen. The results were compared with Tukey-Kramer post test at a significant level (á) of 0.05.

RESULTS: Dentsply SureFil SDR Flow is a posterior flowable restorative intended to be used as base / liner in Class I and II cavities. This material should be used with an occlusal cap layer. In the two-body wear test to simulate the interproximal wear, the wear resistance of SDR Flow is equivalent to that of other flowable / universal / posterior restoratives in the study. In the prophy abrasion test to simulate the proximal wear, the wear resistance of SDR Flow is significantly better than that of other flowable / universal / posterior restoratives in the study.

CONCLUSIONS: Dentsply SureFil SDR Flow's wear resistance is suitable for its intended applications.

Materials	Two-Body Wear		Abrasion Wear
	Volume loss, mm3	Max Depth, µm	Volume loss, mm3
Dentsply TPH3 Flow	0.092 ± 0.050[A]	111 ± 42[A]	6.80 ± 0.18[A]
Dentsply Esthet-X	0.155 ± 0.061[A]	154 ± 35[A]	5031 ± 1.01[B]
3M ESPE Filtek LS	0.166 ± 0.089[A]	155 ± 58[A]	2.64 ± 0.66[C]
Dentsply SDR Flow	0.135 ± 0.067[A]	136 ± 35[A]	0.65 ± 0.19[D]

* All results are given in Mean ± Standard Deviation.
* Levels connected by the same letter are not significantly different.

Friday, March 5, 2010

654

Marginal Assessment of Cavities Restored with a Low-stress Bulk-filling Composite

Location: Room 150B (Walter E. Washington Convention Center)

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OBJECTIVE: The aim of this study was to evaluate microleakage, marginal integrity and gap formation on Class II MOD cavities restored with a novel low-stress bulk-filling low-viscosity composite (Surefil SDR Flow, Dentsply Caulk), and compare its performance with commercially available products.

METHODS: Forty freshly extracted human molars were used in the present study (n=5). A standardized Class II MOD preparation was made in each tooth. The margin of the mesial proximal box was placed in dentin and the distal margin was placed in enamel (1 mm apical or coronal to the CEJ). In groups restored with Surefil SDR Flow, composite placement was made in 4 mm increments. Prepared teeth were randomly assigned to 8 groups according to each protocol: G1-Prime&BondNT/SDR Flow/SDR restorative; G2-XenoIV/SDR Flow/SDR restorative; G3-Prime&BondNT/SDR Flow/EsthetX-HD; G4-XenoIV/SDR Flow/EsthetX-HD; G5-SingleBond2/ Filtek Supreme Plus Flowable/Filtek Supreme Plus, placed per DFU; G6-SingleBond2/Filtek Supreme Plus Flowable/Filtek Supreme Plus, bulk placed; G7-Filtek LS System, placed per DFU; G8-Filtek LS system, bulk placed. Epoxy resin replicas were made for evaluation of marginal integrity under an SEM, before microleakage analysis using a silver impregnation protocol. Restored teeth were sectioned in the mesial-distal direction and replicas were prepared for internal gap evaluation on an SEM. Results were statistically analyzed by 2-way ANOVA and Tukey test.

RESULTS: For the microleakage analysis, enamel margins always performed better than dentin margins. Conversely, marginal integrity on dentin margins was better than enamel margins. Except for G6, all groups presented a similar behavior with regard to microleakage and internal gap formation. Except for G6 an G8, the percentage of gaps formed around cavity margins was not significantly different.

CONCLUSIONS: The performance of the low-stress bulk-filling low-viscosity composite with regard to microleakage, marginal integrity and internal gap formation was similar to commercially available products when placed per DFU.

Wednesday, July 14, 2010

321
The Polymerization Stress of Flowable Composites

Location: Room 113 (CCIB)

B. KOLTISKO, Q. DAI, X. JIN, S. BERTRAND, and H. LU, Dentsply, MIlford, DE

OBJECTIVE: It is well known that composites exhibit volumetric shrinkage upon curing which results in stress on tooth structure. This effect has limited the ability for bulk placement of methacrylate based restorative materials. A unique Stress Decreasing Resin (SDR) technology has been used to develop a flowable composite with very low residual polymerization. The purpose of this study is to compare volumetric shrinkage, modulus and shrinkage stress, and elucidate the mechanisms of stress development in composite systems.

METHODS: SureFil SDR Flow, as well as 6 universal/posterior resin composites and 6 flowable resin composites were selected. Volume shrinkage was determined by Helium Pycnometer. The densities of cured and uncured composites were measured. Flexural modulus was determined according to ISO 4049. Polymerization stress was evaluated by NIST/ADA tensometer. Pastes were injected into a 2.25x6mm cell (C-factor 1.33) and light cured at an intensity of 300-400mw/cm² for 60 seconds. Stress was recorded 60 minutes post-cure.

RESULTS: The volumetric shrinkage of the test composite was 3.5%, which was found to be higher than that of universal composites and slightly lower than that of flowable composites. The flexural modulus of test composite was found in the range of flowable composites (3000 – 8000 MPa). The polymerization stress was 1.49 MPa, which was significantly lower than that of other resin composites tested, ANOVA ($p < 0.05$).

CONCLUSIONS: This study indicates that while volumetric shrinkage and flexural modulus of the test composite were similar to other flowable composites, polymerization stress was lower for this material than other resin composites.

AADR/2008, Dallas, USA

0848
Effects of Restorative Polymerization Stress on Composite Matrix

S. BERTRAND, Q. DAI, X. JIN, and M. O'CONNOR, Dentsply International, Milford, DE

OBJECTIVE: To demonstrate failures of restorations using flowable dental restoratives with different polymerization stress and shrinkage in composite matrix.

METHODS: A prefabricated cylindrical dental composite (10mm x 20mm) with a cavity of 6mm deep x 6mm diameter in the center as the matrix. Flowable dental restoratives were bulk-placed (6mm deep x 6mm diameter, C factor = 5.0) and cured with ordinary bonding agents per DFU. Matrix specimens were thermocycled 5-50°C (500-1000 cycles) Samples were examined at 30-40x magnification before and after thermocycling.

RESULTS: Restoratives having high polymerization shrinkage-stress (greater than 3MPa per NIST beam deflection tensometer, C factor = 1.3) exhibited classic stress-related failures: restorative failure, matrix failure, adhesive failure. Restoratives with lower polymerization stress numbers did not show restoration failures. The volume shrinkage had little effect on the restoration failures.

CONCLUSIONS: In the dental composite matrix model, the polymerization stress of restoratives demonstrates direct effect on restoration failures.

	Volume Shrinkage (%)	Polymerization Stress (Mpa)	Adhesive Failure (%)	Restorative Failure (%)	Matrix Failure (%)
Experimental Flowable Restorative	3.6	1.7	0	0	0
Esthet-X-flow	4.6	3.3	33	33	33
Filtek S. Plus Flow	4.6	3.9	24	44	76
Saremco els flow	3.7	1.2	0	0	0

* Volume Shrinkage determined by Helium Pycnometer – 24hr post cure
** Polymerization Stress determined by NIST Beam Deflection Tensometer: Cfactor 1.3, 60min
*** %Failure = Percentage of test specimens that failed

IADR/2008, Toronto, CANADA

0407

Gap Formation on Occlusal Surfaces Using a Novel Resin Composite

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OBJECTIVES: To evaluate occlusal marginal adaptation of a new resin compared to three commercially available resin brands on Class I restorations.

METHODS: Twenty freshly extracted human molars were randomly divided into four groups (n=5). A standardized Class I preparation 4mm x 4mm x 6mm was made on each tooth with the cavosurface margins defined by a distance of 1 mm from the cusp tips. Restorations were placed according to manufacturer's instructions using the new resin P&P flowable (Dentsply-Caulk, USA) and the commercial resins Z100 (3M ESPE, USA), Filtek Supreme Plus (3M ESPE, USA), and Surefil (Dentsply-Caulk, USA). Epoxy replicas of the occlusal surfaces were prepared and examined under a scanning electron microscope (200X). Marginal gaps and sealed margins were assessed in terms of percentage of total margin length. The total gap area and the number of gaps in each specimen were also determined. One-way analysis of variance (ANOVA) was used to assess whether significant differences existed among study groups at 95% significance.

RESULTS: No significant differences were detected for the mean gap areas (P=0.20) or for the number of gaps (P=0.07). However, significant differences were observed for the percentage of sealed margins (P=0.02). Surefil showed the highest percentage of sealed margin (76%, SD 14%). Values for this resin did not differ (P=0.278) from P&P (62%, SD 31%) but showed statistically significant differences (P=0.036 and P=0.021) respect to Filtek (38%, SD 14%) and Z100 (38%, SD 14%).

CONCLUSIONS: There are material-dependent differences in the occlusal sealing ability among the studied materials. Surefil and P&P showed the highest percentages of sealed margins, while Filtek and Z100 showed lower percentage of sealed margin than Surefil. This study was partially funded by Dentsply/Caulk.

IADR/2008, Toronto, CANADA

0959
Internal Marginal Gap Formation Using a Novel Resin Composite Restorative

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OBJECTIVES: This study evaluated the internal marginal adaptation of a new resin P&P Flowable (P&P) (Dentsply Caulk, USA), compared to three commercially available resins: Z100 (Z); Filtek Supreme Plus (F) (3M ESPE, USA) and Surefil (S) (Dentsply Caulk, USA) on Class I restorations.

METHODS: Class I preparations were made on twenty extracted human molars with the following dimensions: 4mm x 4mm x 6mm, and with the cavosurface margins defined by a distance of 1 mm from the cusp tips. The teeth were randomly divided into four groups (n=5) and restored with the four resins previously described. Each of the tested restorative materials was bonded and restored according to manufacturer's instructions. The specimens were sectioned mesio-distally and replicas of the internal surfaces were obtained using a light viscosity PVS and epoxy resin. The replicas were examined under scanning electron microscope at 200X. Sealed/open margins were assessed in terms of percentage of total margin length. The number of gaps and surface area of the existing gaps were also evaluated. ANOVA was used to evaluate whether significant differences in gap formation existed among groups.

RESULTS: There were significant differences among the tested restorative materials in both percentage of sealed margins ($p<0.001$) and total gap area ($p=0.004$). P&P exhibited the highest percentage of sealed margins and the smallest total gap area. No significant differences were found in the number of gaps ($p=0.08$) among groups. Most gaps occurred on the occlusal third of the axial walls except for Surefil which displayed the most gaps along the pulpal wall.

CONCLUSIONS: Overall, P&P Flowable exhibited the best marginal adaptation and Surefil the worst.
Study partially funded by Dentsply.

IADR/2008, Toronto, CANADA

1818
Determination of Polymerization Stress in Low Shrinkage Resin Composites

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OBJECTIVE: Low shrinkage resin composites are in the focus of research in posterior resin composite restoratives. The aim of this study was to examine the polymerization shrinkage stress of low shrinkage resin composites (Exp. Composite/DENTSPLY, Exp. Flowable/DENTSPLY, ELS/Saremco, Exp.Ormocer/VOCO) and a control (Filtek Silorane/3 M ESPE).

METHOD: Cylindrical cavities (Ø 5mm) in Araldit B epoxide resin plates (40x40x2mm) were pre-treated with the Rocatec system to ensure a bonding of the resin composites. The resin composite specimens (n = 10) were exposed for 60s with a QTH curing device (Translux Energy, Heraeus Kulzer, Germany). The samples were stored dark and dry (23 °C). Polymerization shrinkage stress data [MPa] 4 min and 24 h post exposure were calculated based on the diameter of the isochromatic curves of first order, obtained from the Araldit-plates.

RESULTS: After 24 h the following mean stress values were obtained: 4,6 ± 1,3 MPa for Filtek Supreme XT, 2,8 ± 0,1 MPa for Exp. Composite, 2,7 ± 0,1 MPa for Exp. Flowable, 2,5 ± 0,04 MPa for Filtek Silorane, 2,8 ± 0,2 MPa for ELS. After 24 h, Filtek Supreme XT showed significantly higher polymerization shrinkage stress values compared to all other materials.

CONCLUSION: The new and experimental materials (DENTSPLY) showed shrinkage stress development comparable to Filtek Silorane and ELS. The shrinkage stress developed by Filtek Supreme XT was significantly higher than the shrinkage stress developed by the other composites.

This study was supported by DENTSPLY, Konstanz, and VOCO, Cuxhaven, Germany.

IADR/2009, Miami, USA

1651

New Radically Polymerizable Resins with Remarkably Low Curing Stress

Location: A201 (Miami Beach Convention Center)
X. JIN, S. BERTRAND, and P.D. HAMMESFAHR, DENTSPLY/Caulk, Milford, DE

OBJECTIVE: Curing stress due to constrained polymerization shrinkage remains as a major challenge in current adhesive restoration. Although the accumulated stress within cured composite and its impact on the restored tooth depends upon many factors, resin matrix still is the most crucial one. In this paper, we report a new radically polymerizable resin system for low stress restoratives.

METHODS: Photo-initiator was incorporated into urethane-based methacrylate resins in order to facilitate the radical polymerization and consequently to regulate the overall curing stress. Polymerization shrinkage and curing stress were measured by helium pycnometer and tensometer, respectively.

RESULTS: The photoinitiator was fully incorporated into the resin backbone and therefore required additional photo-initiator for photo-polymerization. The activated resin demonstrated a relatively slow radical polymerization rate, suggesting that the photoinitiator incorporated into the resin is affecting the radical polymerization process. A 60-70% reduction in curing stress was measured in the neat resin when compared to a conventional resin, even though the polymerization shrinkage of the new resin was only 20% less than that of the conventional resin. This lower curing stress is retained in filled compositions, particularly in cases of low filler-loading. Clearly such results indicate that the level of polymerization shrinkage is not necessarily proportional to curing stress.

CONCLUSIONS: A new resin system yields remarkably low curing stress in unfiled resins and in a variety of filled compositions.

	P&P Resin (LB6-114)	P&P II Resin (LB7-18-1)	TPH Resin 999446	BisGMA/TEGDMA (XJ6-186)
Viscosity@20°C (Pa.s)	100	70	15	3
Polymerization Shrinkage (%)	5.94 ± 0.02	5.98 ± 0.10	7.22 ± 0.12	7.70 ± 0.05
Curing Stress (MPa)	1.40 ± 0.05	1.31 ± 0.01	4.72 ± 0.02	3.84 ± 0.01

IADR/2009, Miami, USA

2340
Microtensile Bond Strength of Dentin Replacement and Occlusal Caps

Location: Exhibit Hall D (Miami Beach Convention Center)
Q. DAI, J. GREGORS, S. BERTRAND, and M. O'CONNOR, Dentsply International, Milford, DE

OBJECTIVES: To determine the cohesion between Dentsply adaptable restorative (PP DR) as a dentin replacement and different universal/posterior restoratives as an occlusal cap.

METHODS: In a 10x10x8mm mold, the bottom layer material (dentin replacement) was placed and cured. Immediately after curing, the top layer material (occlusal cap), up to 4mm in thickness, was placed and cured. The cured material was conditioned and cut into 1x1mm sticks with a slow-speed diamond saw and tested for microtensile bond strength on an Instron Tester. 50 specimens were tested for each group. Only the data points of broken only at the dentin/occlusal interface are retained. Then, by eliminating both high-end and low-end data points, the data (> 20 data points) with an overall coefficient of variance (CV) < 40% were analyzed.

RESULTS: When PP DR is capped with Dentsply universal/posterior restoratives, the cohesion between PP DR and the occlusal cap is equivalent to or better than that of Esthet-X body and Esthet-X enamel. For other products, the cohesion between PP DR and the enamel cap is at least as good as that between the cap materials themselves in layered placements per manufacturers' recommendations.

CONCLUSION: Dentsply adaptable restorative PP DR is compatible with methacrylate composite systems used as an alternate occlusal cap.

Dentin Replacement – Occusal Cap	Microtensile Bond Strength, Mpa
Dentsply Restoratives	
Esthet-X A2 – Esthet-X CE	43.3 ± 4.3
PP DR – Esthet-X CE	64.1 ± 5.4
PP DR – Quixx	54.0 ± 3.7
PP DR – TPH 3 CE	76.0 ± 4.4
PP DR Esthet-X HD A2	58.2 ± 5.1
Other Restoratives	
3M Filtek Supreme Plus A2B – 3M Filtek Supreme Plus WE	39.5 ± 5.3
PP DR – 3M Filtek Supreme Plus WE	59.3 ± 10.7
Voco Grandio A2 – Voco Grandio Incisal	66.1 ± 6.8
PP DR – Voco Grandio Incisal	68.9 ± 3.3
Kerr Premise A2 – Kerr Premise CT	50.1 ± 6.1
PP DR – Kerr Premise CT	47.2 ± 5.3

* All data are given in 95% confidence intervals using t-test.

IADR/2009, Miami, USA

2426

In-Vitro Evaluation of Mechanical and Physical Properties of Low-Shrink Composites

Location: Exhibit Hall D (Miami Beach Convention Center)

T. GHUMAN, P. KADAM, D. CAKIR, L. RAMP, and J. BURGESS, University of Alabama, Birmingham, AL

Innovative composite materials with monomers that reduce shrinkage and/or shrinkage stress are needed for clinically acceptable restorations.

OBJECTIVES: To compare wear, polymerization shrinkage and shear bond strength of low-shrink or low-stress composites to a commercially available composite.

METHODS: **Wear** Composite disks (t=4mm) were light cured in 2mm increments (n=8), mounted in brass holders and stored (24h, 37°C). Specimens were loaded into an Alabama Wear Testing Device for (400,000 cycles,72Hz, 75N), simulating three-body wear in slurry of 50mm PMMA beads. Wear depth and volumetric loss was determined using 3D non-contact profilometer (Proscan2000). **Shrinkage** Specimens (n=5) were placed into ACUVOL and light cured. %volume shrinkage was recorded after 7min following curing. **Bond strength** 100 extracted molars (n=10) were wet ground with 320-grit SiC paper to expose enamel and dentin. Adhesives were applied according to manufacturers' instructions. Plastic tubes (diameter=1.5mm) filled with composite was bonded onto the adhesive, stored (370C,24h) and tested (Instron-5565/1mm/min). Data were analyzed with ANOVA and Tukey/Kramer post-hoc tests.

RESULTS: Significant differences between Adaptable and N'Durance for wear volume and depth were recorded. Polymerization shrinkage for N'Durance and Universal were not significantly different but all other materials were. Shear bond strength of N'Durance Adhesive System was significantly lower than other materials ($p<0.0001$).

CONCLUSION: Multiple properties must be examined to provide enough information for proper composite resin selection.

Composite Material	Wear		Polymerization Shrinkage (%)	Adhesive Systems	Shear Bond Strength (MPa)	
	Vol (mm≥)	Depth (µm)			Enamel	Dentin
Filtek Supreme Plus (3M ESPE)	0.021 ± 0.01	45.2 ± 15.1	1.9 ± .3	ScotchBondSE	19.7 ± 4	18.1 ± 3
Filtek Silorane (3M ESPE)	0.094 ± 0.06	148.8 ± 19	1 ± 0.1	Silorane System Adhesive	22.1 ± 2	19.5 ± 2
N'Durance (Septodent)	0.052 ± 0.06	127.8 ± 134	2.6 ± 0.1	Image Bond SE	11 ± 3	12.5 ± 3
Universal (Expt.)	0.079 ± 0.06	140.4 ± 15	2.6 ± 0.2	Prime & Bond NT	18.3 ± 5	22.4 ± 4
Adaptable (Expt.)	0.156 ± 0.05	223.5 ± 25	3.1 ± 0.3	Prime & Bond NT	22.5 ± 4	22.5 ± 6

IADR/2009, Miami, USA

2445
Curing Stress and Depth of Cure for Novel Adaptable Restorative

Location: Exhibit Hall D (Miami Beach Convention Center)
S. BERTRAND, Q. DAI, X. JIN, and M. O'CONNOR, Dentsply International, Milford, DE

OBJECTIVE: To compare curing stress and depth of cure of newly developed adaptable restorative (P&P DR) with six conventional flowable composites.

METHODS: Curing stress was determined by NIST tensometer 6x2.25mm, Cfactor = 1.33). Specimens were cured 60" with halogen light atΦ(400mw/cm²). The maximum stress during 60 minutes duration was taken. ISO4049 depth of cure was performed as prescribed.

RESULTS: (see table)

CONCLUSIONS: The unique combination of exceptionally low curing stress and higher depth of cure allows bulk placement of new adaptable restorative.

	P&P DR Universal Shade	TPH3 Flow A2	Esthet-X Flow A2	Filtek Supreme Plus Flow A2	TetricEvo Flow A2	Premise Flow A2	GrandiO Flow A2
Stress by NIST Tensometer (Mpa)	1.5 ± 0.1	3.2 ± 0.1	3.0 ± 0.2	4.1 ± 0.2	2.9 ± 0.0	3.2 ± 0.1	> 3.9
ISO Depth of Cure 20" exposure (mm)	4.3 ± 0.2	3.3 ± 0.1	3.3 ± 0.1	2.6 ± 0.1	1.8 ± 0.2	2.4 ± 0.1	2.8 ± 0.1

* All data are given in 95% confidence intervals using t-test.

IADR/2009, Miami, USA

2848

Bond Performance of a Low-Stress Composite in Class I Cavities

Location: A104-105 (Miami Beach Convention Center)
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OBJECTIVES: This study evaluated the microtensile bond strength (µTBS) and microleakage in Class I cavities restored with a novel low-stress composite and compared its performance with commercially available products.

METHODS: Twenty third molars were used for the µTBS and 20 for the microleakage analysis (n=5). Class I cavities measuring 5mm(depth)x4mm(bucco-lingual)x6mm(mesio-distal) were restored according to four different protocols: G1 – Prime&Bond NT + P&P (4mm bulk placement + 1mm cap); G2 – Xeno IV + P&P (4mm bulk placement + 1mm cap); G3 Single Bond Plus + Supreme Plus Flow and Filtek Supreme Plus Universal (oblique incremental layering technique); G4 - Filtek LS system (horizontal incremental layering technique). For the µTBS study, specimens were sectioned into slabs that were trimmed to obtain a cross-sectional bonded area of 0.8mm2 on the pulpal floor of the cavities. Specimens were tested in tension at 1mm/min. For the microleakage study, specimens were submitted to a silver impregnation protocol and photodeveloped. Three 0.9 mm thick slabs were obtained from each tooth and microleakage was recorded as a percentage of cavity size. Results were statistically analyzed by ANOVA and Tukey test.

RESULTS: Bond strength values in MPa ± SD were: G1 – 50.8±6.2a; G2 – 20.1±4.0b; G3 – 23.5±5.1b; G4 – 16.6±4.7b. Microleakage values (%) ± SD were: G1 – 2.3±2.0a; G2 – 6.6±5.4a ; G3 – 33.1±19.1b; G4 – 48.4±24.8b. The highest bond strength values were obtained when the low-stress composite resin was used with the etch-and-rinse adhesive Prime&Bond NT. The lowest microleakage values were observed when the low-stress composite resin was used.

CONCLUSIONS: Bond strength values to the pulpal wall in high C-factor cavities restored with the low-stress composite resin bulk placed was higher than or comparable to commercially available products. Very low microleakage was observed for the novel composite resin.

Supported by Dentsply/Caulk