Welcome

Once again 3M ESPE has the distinct privilege to support the International Association for Dental Research (IADR) and their premier global conference for the sharing and communication of scientific and technological advancements in oral care. We are very proud of our connection and collaboration with the IADR which now has 14 years of very positive history.

Through our Expertise™ brand, our goal is to provide independent, objective information on trends and innovations in dentistry and to provide educational programs that help you stay not only current, but also ahead of new advances in dental materials and techniques.

With our own research and development efforts and connections to dental researchers and professionals of all kinds around the world, we are committed to turning research into products and solutions that benefit dentists, hygienists and their patients. The results that come from this commitment have allowed us to be named the “Most Innovative Company in the Dental Industry” for the last seven years. The ranking each year is based on issued patents worldwide, 510k applications and new product introductions.

We hope you enjoy and find value in this most recent collection of Scientific Facts. In addition to the abstracts, there are also additional “references” at the end of the Direct and Indirect sections that feature 3M ESPE products for you to review.

Whether you are at the IADR global conference or not, we also hope you continue to engage our researchers and scientists as we all work to help make better dentistry possible.

Sincerely,

Dr.med.dent. Gerhard Kultermann
Head of Global Scientific Marketing
3M ESPE
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Scotchbond™ Universal Adhesive

Evaluation of a New Universal Adhesive Using Different Bonding Strategies

J. PERDIGAO, Dept. of Restorative Sciences, University of Minnesota, Minneapolis, MN; A. SEZINANDO, CiEM, Centro de Investigação Interdisciplinar Egas Moniz, Instituto Superior de Ciências da Saúde Egas Moniz, Monte da Caparica, Portugal and P. MONTEIRO, CiEM, Centro de Investigação Interdisciplinar Egas Moniz, Instituto Superior de Ciências da Saúde Egas Moniz, Monte da Caparica, Portugal

Objectives: To measure the dentin/enamel microtensile bond strengths (µTBS) of a novel universal adhesive.

Methods: Dentin — 36 human molars (middle dentin) were assigned to 6 groups (n = 6): (1) Group CSE – Clearfil SE Bond (Kuraray), a 2-bottle self-etch adhesive (self-etch control); (2) Group OSL – OptiBond SOLO Plus (Kerr), a 2-bottle etch and rinse adhesive applied on etched moist dentin (etch and rinse control); (3) Group OSLd – OSL applied on etched dried dentin; (4) Group SBU-SE – Scotchbond Universal Adhesive (SBU, 3M ESPE), a 1-bottle universal adhesive, applied as a self-etch adhesive; (5) Group SBU-ERm – SBU applied as an etch and rinse adhesive on etched moist dentin; (6) Group SBU-ERd – SBU applied as an etch and rinse adhesive on etched dried dentin.

Enamel — 24 enamel rectangles from 12 human molars were assigned to three groups: (7) SBU-SE; (8) OSL; (9) SBU-ERm. Buildups were constructed with Filtek™ Z250 Universal Restorative. Specimens were sectioned with a slow-speed diamond saw to obtain bonded sticks which were tested to failure in tension mode at a crosshead speed of 1mm/min. Statistical analyses (separate for enamel and for dentin) were computed using ANOVA followed by Duncan’s test at p < 0.05.

Results: MPa ± SD, different superscript letters indicate statistical difference.

<table>
<thead>
<tr>
<th></th>
<th>CSE</th>
<th>OSL</th>
<th>OSL-d</th>
<th>SBU-SE</th>
<th>SBU-ERm</th>
<th>SBU-ERd</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dentin</td>
<td>47.2 ± 22.9c</td>
<td>63.0 ± 25.0a</td>
<td>50.2 ± 20.6bc</td>
<td>54.4 ± 18.5b</td>
<td>54.0 ± 18.8b</td>
<td>53.9 ± 18.4b</td>
</tr>
<tr>
<td>Enamel</td>
<td>—</td>
<td>41.1 ± 17.6A</td>
<td>—</td>
<td>28.7 ± 10.5h</td>
<td>40.1 ± 17.9h</td>
<td>—</td>
</tr>
</tbody>
</table>

Dentin — OSL resulted in significantly higher mean µTBS than those of the other five groups. All SBU groups ranked in the same statistical subset regardless of the dentin treatment. The lowest mean µTBS was obtained with CSE, but was not statistically different from that of OSLd.

Enamel — OSL and SBU-ERm resulted in statistically similar mean µTBS, which were statistically higher than those of SBU-SE.

Conclusions: On dentin, SBU was not affected by the adhesion strategy or by dentin moisture. On enamel, phosphoric acid etching is still recommended.

3M ESPE Summary

Aim of Study: To determine the bond strengths for Scotchbond Universal Adhesive to self-etched dentin and etched dentin that has been left moist and dried. This will evaluate the reduction in technique variability. The bond strength to etched and self-etched cut enamel was also evaluated.

Summary of Results: Scotchbond Universal Adhesive provided for consistent bonding to dentin in the self-etch mode and the etched moist and dry modes. The adhesion was not affected by varying moisture or dryness levels on the dentin following etching.
Scotchbond™ Universal Adhesive

Postoperative Sensitivity with a New Universal Adhesive

R. GUGGENBERGER1, B. CERNY1, C. THALACKER1, K. WIGGINS2 and A.B. SOARES3, 1Dept. of Research & Development, 3M ESPE Dental Products, Seefeld, Germany, 23M ESPE Dental Products, Saint Paul, MN, 33M ESPE Dental Products, Sao Paulo, Brazil

Objectives: The new Scotchbond Universal Adhesive (SBU, 3M ESPE) can be applied either with or without a prior phosphoric acid etch, depending on the preference of the dentist. Aim of this work was to compare the occurrence of initial post-operative sensitivities (POS) for the different application modes total-etch (TE), self-etch (SE), selective enamel etch (SEE) of SBU.

Methods: SBU was evaluated by 120 dentists in a non-interventional study. The dentists were asked in which application modes they applied SBU, how many cases they performed and about the occurrence of POS.

Results: The table summarizes the pooled data (n = 120 dentists). Occurrence of POS was analyzed by pair-wise comparisons using Fisher’s Exact Test (p < 0.05). Values with the same letter are statistically the same.

<table>
<thead>
<tr>
<th>Application mode</th>
<th>Number of cases</th>
<th>Number of POS cases</th>
<th>Percentage of POS cases [%]</th>
</tr>
</thead>
<tbody>
<tr>
<td>TE</td>
<td>3467</td>
<td>14^A</td>
<td>0.4^A</td>
</tr>
<tr>
<td>SE</td>
<td>3495</td>
<td>2^B</td>
<td>0.1^B</td>
</tr>
<tr>
<td>SEE</td>
<td>1544</td>
<td>0^B</td>
<td>0.0^B</td>
</tr>
</tbody>
</table>

Conclusions: With respect to literature data on adhesive restorations, the number of POS cases with SBU was very low for all application modes. Occurrence of POS was found to be significantly lower for SE and SEE than for TE modes.

3M ESPE Summary

Aim of Study: To record and compare the occurrence of initial post operative sensitivity for patients when Scotchbond Universal Adhesive was used in various modes of etching (total-etch, self-etch or selective enamel etch).

Summary of Results: Scotchbond Universal Adhesive provided for very low levels of post operative sensitivity for all application modes.
Scotchbond™ Universal Adhesive (EXL 759)

Sealing Abilities of Latest All-In-One Adhesives Under Thermo-Mechanical Cyclic Stress

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Objectives: The purpose of this study was to examine the sealing ability of a latest experimental all-in-one adhesive; EXL 759 (EXL, 3M ESPE), as compared with an all-in-one system; Adper™ Easy Bond Adhesive (EB, 3M ESPE) and a popular self-etch system; Clearfil SE Bond (SE, Kuraray), under thermo-mechanical cyclic stress simulating intra-oral environment.

Methods: 60 standardized wedge-shaped cavities with occlusal margin on enamel and gingival margin on dentin were prepared in the buccocervical region of extracted human lower premolars. Three systems were applied to the cavities according to manufacturer’s instruction and resin composites Filtek™ Supreme Ultra Universal Restorative (3M ESPE) for EXL and EB specimens and Clearfil AP-X (Kuraray) for SE specimens, were placed and light-cured. All specimens were stored in a moisture box at 37°C for 24 hours, then polished and divided into two groups (n = 10, each system); a group with stress (S+) and a group without stress (S-). For S+ group, restored specimens were thermocycled (5°C/55°C, 2,000 cycles) and cyclic loaded (12kg x 105) simultaneously. For S- group, no stress was applied. Dyeing for an hour, microleakage of S+ and S- specimens were evaluated by a graded criterion and analyzed using Kruskal-Wallis and Wilcoxon tests.

Results: There were significant differences in occlusal microleakage between S+ and S- groups in EXL (p < 0.05), EB (p < 0.01) and SE (p < 0.05), while the differences in gingival leakage was not recognized regardless of the systems. There were no differences in both occlusal and gingival microleakage among the systems regardless of stress mode. The difference in the microleakage of each system between occlusal and gingival walls was not recognized, regardless of stress mode.

Conclusions: Gingival microleakage of all systems was not influenced by the stress, but occlusal leakage increased by the stress. However the sealing ability of EXL was statistically equivalent to those of EB and SE regardless of stress mode and walls.

3M ESPE Summary

Aim of Study: To evaluate the sealing ability at the occlusal enamel and the gingival dentin margins for Scotchbond Universal Adhesive compared to Adper Easy Bond Adhesive and Clearfil SE with and without thermo and mechanical stressing.

Summary of Results: The sealing ability for both margins was statistically the same for the three adhesives.
Interfacial Characterization of a New Universal Dentin Adhesive

A. SEZINANDO, CiiEM, Centro de Investigação Interdisciplinar Egas Moniz, Instituto Superior de Ciências da Saúde Egas Moniz, Monte da Caparica, Portugal and J. PERDIGAO, Department of Restorative Sciences, University of Minnesota, Minneapolis, MN

Objectives: To study the dentin-resin interface and nanoleakage of a novel universal adhesive.

Methods: Dentin — 12 human molars (middle dentin) were assigned to 6 groups: (1) Group CSE – Clearfil SE Bond (Kuraray), a 2-bottle self-etch adhesive (self-etch control), (2) Group OSL – OptiBond SOLO Plus (OSL, Kerr), a 2-bottle etch and rinse adhesive applied on etched moist dentin (etch and rinse control), (3) Group OSL-d – OSL applied on etched dried dentin, (4) Group SBU-SE – Scotchbond Universal Adhesive (SBU, 3M ESPE), a 1-bottle universal adhesive, applied as a self-etch adhesive, (5) Group SBU-ER – SBU applied as an etch and rinse adhesive on etched moist dentin, (6) Group SBU-ERd – SBU applied as an etch and rinse adhesive on etched dried dentin. Specimens were restored and processed for FESEM evaluation. For nanoleakage assessment, 42 sound molars were randomly assigned to the same experimental groups with an additional group 7 (selective enamel-etching, SBU-En). Buccal and lingual class V preparations were restored with Filtek™ Z250 Universal Restorative and processed with 50% ammoniacal silver nitrate. After sectioning, specimens were observed under a stereomicroscope to evaluate the depth of silver penetration (0—4). The scores were compared using Mann-Whitney test (p < 0.05). Selected specimens were processed for backscattered FESEM to evaluate the nanoleakage pattern into the resin-dentin interface.

Results: SBU-SE and CSE formed a continuous dentin-resin interface with a 0.2μm–0.3μm thick hybrid layer (HL). Air-drying did not affect the HL for SBU-ERd. OSL-d resulted in an inconsistent HL with areas of debonding. SBU-SE and SBU-En resulted in statistically lower silver infiltration than all other groups. These two adhesives virtually prevented nanoleakage in all specimens. CSE and OSL were ranked in the intermediate subset. OSL-d, SBU-ER and SBU-ERd resulted in significantly greater silver penetration than the remaining groups.

Conclusions: SBU-SE and CSE form a very similar resin-dentin interface/HL. SBU-SE and SBU-En (selective enamel-etching) seal dentin margins.

3M ESPE Summary

Aim of Study: To evaluate the dentin/adhesive interface for Scotchbond Universal Adhesive when applied in the self-etch mode and the etched moist and dry mode. The formulation of Scotchbond Universal Adhesive is designed to allow for consistent bonding.

Summary of Results: Scotchbond Universal Adhesive provided for a consistent hybrid layer to the etched dentin which was left moist and also dried. Optibond Solo Plus had an inconsistent hybrid layer to the etched and dried dentin. The performance of Scotchbond Universal Adhesive should provide for less technique sensitivity.
Shear Bond Strength to Restorative Materials and Tooth Structure

J. BURGESS, S. SHAH, D. CAKIR, P. BECK and L. RAMP, University of Alabama at Birmingham, Birmingham, AL

Objectives: 1) Measure 24-hour and thermocycled shear bond strength (SBS) of Scotchbond Universal/3M ESPE to Paradigm™ C Block, Lava™ Core, IPS e.max CAD, gold and base metal alloy. 2) Measure 24-hour and 10 month SBS of an experimental adhesive to unetched and etched ground human dentin and enamel.

Methods: Paradigm C block, e.max CAD, Lava blocks and non-noble metal alloy were sectioned (t = 4mm). Noble metal alloy was received in 2mm thick blocks. Specimens were polished (180-, 320-grit SiC-paper/4mins), finished (0.5μ Al2O3 slurry/2mins) and cleaned (ultrasonic/distilled water/15 seconds). Molars were wet-ground (320-grit) to obtain flat enamel and dentin. Following surface treatments (table) and bonding agent application, Z100™ Restorative/3M ESPE cylinders (d = 1.5mm) were bonded and light-cured (Elipar™ S10 LED Curing Light/3M ESPE/1000mW/cm²). Half were debonded after 24 hours storage/37°C (Instron-1mm/minute). Remainder of ceramic and alloy specimens were debonded after thermocycling (10,000 cycles/6-60°C/15 seconds dwell time). Remaining enamel and dentin specimens were stored for 10 months after thermocycling then debonded. Data analyzed with ANOVA and Tukey/Kramer post-hoc tests (p = 0.05).

Results: MPa/(Mean ± SD) Same letters in same row are not statistically different.

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<th>Metal Alloys/Ivoclar</th>
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<td>HF Etch-Sultan/ESPE Sil</td>
<td>CoJet-30μm-ESPE Sil</td>
<td>Al2O3-50μm/Metal PrimerII</td>
</tr>
<tr>
<td>Scotchbond Universal/SU</td>
<td>HF Etch-Sultan</td>
<td>Al2O3-50μm</td>
<td>Al2O3-50μm/Metal PrimerII</td>
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<th>SU/Etched</th>
<th>Easy Bond/EB</th>
<th>SBP</th>
</tr>
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<tr>
<td></td>
<td>24 hours</td>
<td>10 months</td>
<td>24 hours</td>
<td>10 months</td>
</tr>
<tr>
<td>Enamel</td>
<td>26.8 ± 5A</td>
<td>33.6 ± 6A</td>
<td>27.6 ± 6A,5B</td>
<td>37.4 ± 6A</td>
</tr>
<tr>
<td>Dentin</td>
<td>30.4 ± 9A</td>
<td>28.4 ± 5A</td>
<td>34 ± 7A</td>
<td>26 ± 7A</td>
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| Dentin                | 29.9 ± 11A  | 28.6 ± 11A | 38.9 ± 8A    | 34 ± 12A |

<table>
<thead>
<tr>
<th>Lava</th>
<th>SBP/Silane</th>
<th>SBP/RelyX-Ceramic Primer</th>
<th>SU/HF-Etch</th>
</tr>
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<tbody>
<tr>
<td></td>
<td>24 hours</td>
<td>10,000 cycles</td>
<td>24 hours</td>
</tr>
<tr>
<td></td>
<td>36.8 ± 4A</td>
<td>40.6 ± 7A</td>
<td>34.2 ± 7A</td>
</tr>
<tr>
<td>Paradigm C</td>
<td>44.1 ± 16A</td>
<td>32.7 ± 12A,5B</td>
<td>27 ± 10A</td>
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</table>

<table>
<thead>
<tr>
<th>Lava</th>
<th>SBP/Cojet+Silane</th>
<th>SBP/AI2O3+Z Prime</th>
<th>SU/AI2O3</th>
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<tr>
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<td>24 hours</td>
<td>10,000 cycles</td>
<td>24 hours</td>
</tr>
<tr>
<td></td>
<td>19.8 ± 5A</td>
<td>32.3 ± 7A</td>
<td>37.5 ± 5A</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Base-Metal</th>
<th>SBP/AI2O3+Metal Primer</th>
<th>SU/AI2O3</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>24 hours</td>
<td>10,000 cycles</td>
</tr>
<tr>
<td></td>
<td>29.1 ± 5A</td>
<td>40.2 ± 5A</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Noble-Metal</th>
<th>SBP/AI2O3+Metal Primer</th>
<th>SU/AI2O3</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>24 hours</td>
<td>10,000 cycles</td>
</tr>
<tr>
<td></td>
<td>30.6 ± 5A</td>
<td>29.1 ± 4A</td>
</tr>
</tbody>
</table>

Long term storage did not affect enamel and dentin SBS. SBS decreased after 10,000 thermal cycles for: e.max: SBP/Silane, SU, Zirconia: SU. Base Metal Alloy: SU. Noble Metal Alloy: SBP, SU.

Conclusions: Scotchbond Universal Adhesive is a promising universal adhesive. Supported in part by 3M ESPE.

continued on next page >
3M ESPE Summary

Aim of Study: To evaluate the shear bond strength for Scotchbond™ Universal Adhesive to dentin, enamel and a variety of indirect restoration materials (glass ceramic, zirconia and metals) to show the versatility of the adhesive to bond to many different substrates.

Summary of Results: The unique chemistry of Scotchbond Universal Adhesive allows it to provide high and consistent bond strengths to a variety of dental surfaces.
Scotchbond™ Universal Adhesive (SEA)

Bond of a New Self-Etch Adhesive to Alumina and Zirconia

M.B. BLATZ, C. ZBAEREN and F. MANTE, Department of Restorative Dentistry, University of Pennsylvania, Philadelphia, PA

Objectives: This study measured and compared the shear bond strength of resin composite to the high-strength ceramics alumina and zirconia after different surface treatment methods and application of either a new self-etch adhesive or a prominent zirconia primer.

Methods: A total of 72 specimens were fabricated from a commercially available zirconium-oxide ceramic (Lava™ Zirconia, 3M ESPE, n = 36, group ZIR) and an aluminum-oxide ceramic (Vita, n = 36, group ALU). Surface treatment protocols consisted of air-particle abrasion (aluminum oxide) followed by application of a new self-etch adhesive (3M ESPE, subgroup SEA) or Z-Prime (Bisco, subgroup ZPR). As a control, a combination of CoJet™ System tribochemical surface treatment, ceramic primer (RelyX™ Ceramic Primer, 3M ESPE) and an adhesive (Adper™ Single Bond Plus Adhesive, 3M ESPE) was applied (subgroup COJ). Bond strength was tested after 10,000 thermal cycles (5 to 600°C, dwell time 15 seconds). Data was analyzed with one-way ANOVA (p < 0.001) and paired comparisons between groups were done with Tukey test (p < 0.05).

Results: For group ZIR, mean bond strength values [MPa] and SD were: SEA 23.19 ± 4.49 (a), ZPR 10.97 ± 2.53 (b), COJ 0.82 ± 0.49 (c). For group ALU, they were: SAE 17.49 ± 3.67 (a), ZPR 7.05 ± 1.64 (b), COJ 1.09 ± 0.81 (c). Same letters in parentheses indicate no statistically significant difference.

Conclusions: Type of adhesive and surface treatment significantly influence composite-resin bond strengths to zirconia and alumina. Performance of the different bonding protocols was not influenced by the ceramic substrate. The new self-etch adhesive (SEA) provides superior bond strength to zirconia as well as alumina ceramics.

3M ESPE Summary

Aim of Study: To evaluate the shear bond strength for Scotchbond Universal Adhesive to alumina and zirconia.

Summary of Results: Scotchbond Universal Adhesive provided superior bond strength to zirconia and alumina compared to conventional pre-treatment methods.
Scotchbond™ Universal Adhesive

Total-Etch Performance of One Bottle Self-Etch Adhesives

C. THALACKER, H. LOLL, C.A.C WIEDIG, D.D. KRUEGER, 3M ESPE, Seefeld, Germany

Objectives: Recently a combined total-etch (TE) and self-etch (SE) one bottle adhesive was introduced (Scotchbond™ Universal, SBU, 3M ESPE). Aim of this study was to assess the shear bond strength (SBS) of current one bottle SE adhesives and SBU in SE and TE modes. Moisture tolerance in TE was assessed by measuring SBS to moist and air-dried etched dentin.

Methods: Bovine incisors were embedded in cold-cure acrylic resin. The labial surface of each tooth was ground to expose enamel (E) or dentin (D). A cylindrical button of Filtek™ Z250 Universal Restorative A3 (3M ESPE, 2.36mm diameter, 2mm height) was cured on the tooth surfaces treated with Scotchbond Universal Adhesive (SBU, 3M ESPE), Xeno IV (XE4, Dentsply), Xeno V+ (XE5, Dentsply), Clearfil SE Bond, (CSE, Kuraray), G-aenial Bond (GAE, GC), iBond SE (IBS, Heraeus Kulzer), Optibond All-in-one (OAI, Kerr), AdheSE One F (AOF, Ivoclar-Vivident) in SE mode according to the manufacturer’s instructions and in TE mode after a 15s phosphoric acid etch (n = 6). A notched-edge shear method (Ultradent) was used to measure the SBS.

Results: The table shows the SBS in MPa. The standard deviations (SD) are given in parentheses. All data per substrate were analyzed by ANOVA and multiple comparisons using Fisher’s LSD procedure (p < 0.05). Means with the same letters are statistically the same.

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<tbody>
<tr>
<td>SBU</td>
<td>27.7 (5.5)a</td>
<td>28.7 (5.3)a</td>
<td>32.8 (4.8)a</td>
<td>29.3 (4.7)a</td>
<td>21.8 (3.3)a</td>
</tr>
<tr>
<td>XE4</td>
<td>18.1 (2.5)b</td>
<td>28.4 (5.8)a</td>
<td>29.3 (6.0)b</td>
<td>28.8 (7.7)a</td>
<td>15.0 (2.1)b</td>
</tr>
<tr>
<td>XE5</td>
<td>13.1 (7.1)bc</td>
<td>13.9 (4.0)bc</td>
<td>19.5 (4.9)cd</td>
<td>15.4 (2.8)bc</td>
<td>17.4 (5.2)b</td>
</tr>
<tr>
<td>GAE</td>
<td>22.2 (2.9)b</td>
<td>13.1 (3.5)bc</td>
<td>21.8 (2.9)cd</td>
<td>12.4 (1.8)b</td>
<td>9.5 (3.3)b</td>
</tr>
<tr>
<td>IBS</td>
<td>19.8 (3.0)b</td>
<td>12.5 (1.4)b</td>
<td>23.4 (5.1)b</td>
<td>13.1 (1.9)b</td>
<td>7.4 (0.9)b</td>
</tr>
<tr>
<td>OAI</td>
<td>22.7 (5.2)bc</td>
<td>31.0 (3.0)b</td>
<td>35.4 (1.3)a</td>
<td>19.1 (2.2)b</td>
<td>11.0 (5.2)cd</td>
</tr>
<tr>
<td>AOF</td>
<td>13.1 (1.4)bc</td>
<td>15.3 (0.7)b</td>
<td>17.3 (1.7)b</td>
<td>16.6 (0.2)bc</td>
<td>14.1 (3.9)bc</td>
</tr>
</tbody>
</table>

Conclusions: Multiple statistically significant differences were found. SBU yielded equivalent or higher SBS in SE and TE modes than the one bottle SE adhesives.

3M ESPE Summary

Aim of Study: To assess the shear bond strength of current one bottle self-etch adhesives and Scotchbond Universal Adhesive in self-etch and total-etch modes. Moisture tolerance in total-etch was assessed by measuring adhesion to moist and air-dried etched dentin.

Summary of Results: Scotchbond Universal Adhesive provided high bond strengths in all modes of use compared to the other self-etching adhesive systems.
Scotchbond™ Universal Adhesive (EXL 759)

Shear Bond Strength of Selective-Etch Adhesives on Cut/Uncut Enamel

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Objectives: To compare shear bond strength of 7th generation adhesive systems on cut and uncut enamel prepared with selective-etch or preferential etch technique.

Methods: One-hundred extracted caries-free human teeth were obtained for this study. Each tooth was embedded in acrylic resin. The samples were randomly divided into ten groups (n = 10, five groups cut [C], five uncut [U]). Cut enamel surfaces were prepared using SiC paper up to 600 grit (Ecomet3, Buehler). Uncut were embedded with their buccal surface exposed. Three adhesive systems were tested with variations in etching: Prime&Bond NT (PBNT, Dentsply), Adper™ Easy Bond Adhesive (AEB, 3M ESPE) and experimental adhesive EXL 759 (EXL, 3M ESPE). Adhesives were applied according to manufacturers’ instructions with exceptions of using the self-etch mode (SE) or pre-treating with etch (PE). Filtek™ Z250 Universal Restorative (3M ESPE) composite was filled into a bonding jig (Ultradent) and cured for 40 seconds with a halogen light (Elipar™ Curing Light 2500). After storage in de-ionized water for 24 hours at 37°C, the shear bond strength was carried out using a universal testing machine (Instron 5566A, Norwood, MA) with a cross head speed at 1mm/minute. Statistical analysis was done by one-way ANOVA, with post-hoc analysis conducted via Fisher LSD. Significance was predetermine at p < 0.05.

Results:

<table>
<thead>
<tr>
<th></th>
<th>PBNT, C</th>
<th>PBNT, U</th>
<th>AEB, C</th>
<th>AEB, U</th>
<th>AEB, C</th>
<th>AEB, U</th>
<th>EXP, C</th>
<th>EXP, U</th>
<th>EXP, C</th>
<th>ECP, U</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean (MPA)</td>
<td>PE</td>
<td>PE</td>
<td>PE</td>
<td>PE</td>
<td>SE</td>
<td>SE</td>
<td>PE</td>
<td>SE</td>
<td>PE</td>
<td>SE</td>
</tr>
<tr>
<td></td>
<td>31.93</td>
<td>32.03</td>
<td>35.18</td>
<td>31.10</td>
<td>26.56</td>
<td>26.06</td>
<td>34.11</td>
<td>41.65</td>
<td>23.51</td>
<td>36.86</td>
</tr>
<tr>
<td>SD</td>
<td>± 4.99</td>
<td>± 9.26</td>
<td>± 4.03</td>
<td>± 7.61</td>
<td>± 5.83</td>
<td>± 11.20</td>
<td>± 5.68</td>
<td>± 7.11</td>
<td>± 6.47</td>
<td>± 11.81</td>
</tr>
<tr>
<td>Statistic Group Comparison</td>
<td>a,d</td>
<td>a,e</td>
<td>b,c,d,e,h</td>
<td>a,c</td>
<td>a,c,f</td>
<td>a,c</td>
<td>b,c,d,e</td>
<td>b,f,h</td>
<td>a,c,d</td>
<td>b,c,d,e,g</td>
</tr>
</tbody>
</table>

Conclusions: In terms of mean values, EXP with selective-etch has higher bond strength than AEB self-etch on both cut and uncut enamel. Uncut enamel yields significantly higher bond strength compared with the cut enamel on EXP self-etch.

3M ESPE Summary

Aim of Study: To compare the shear bond strength to etched and unetched, cut and uncut enamel in both the total-etch and self-etch modes for Scotchbond Universal Adhesive compared to Adper Easy Bond Adhesive and Prime&Bond NT.

Summary of Results: Scotchbond Universal Adhesive provided high bond strengths to enamel for all situations.
Scotchbond™ Universal Adhesive

Influence of Curing Units on One-Step Self-Etch Adhesives

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Objectives: To determine the effect of different curing units on microshear bond strength to enamel using one-step self-etch adhesives. The tested hypothesis was that curing unit type affects the bond strength of adhesives.

Methods: One-hundred and eighty human molars were used. Teeth were randomly divided in three main groups, according to the adhesive system used (n = 60): Scotchbond Universal Adhesive (3M ESPE); G-BOND (GC Corporation) and MTB-200 (Kuraray). Each adhesive system was applied according to manufacturer’s instructions. Each group was divided in three subgroups according to the type of curing unit used (n = 20): Bluephase-LED (Ivoclar Vivadent), VALO-LED (ULTRADENT) and Elipar™ 2500 Curing Light – halogen (3M ESPE). A composite (Filttek™ Supreme Z250 Universal Restorative, 3M ESPE) build-up was created on the bonded enamel surface and immediately tested for microshear bond strength testing. Specimens were loaded to failure and data statistically-analyzed by one-way Anova and Tukey’s post-hoc test (p < 0.05).

Results: Microshear values are reported in Table 1. G-bond showed lower bond strength than the other adhesives with all the tested curing units. Curing unit type did not affect MTB-200, while Scotchbond Universal Adhesive polymerized with Bluephase showed the highest values.

Table 1: Means (MPa ± SD) of microshear bond strength of the tested adhesives.

<table>
<thead>
<tr>
<th>Scotchbond Universal Adhesive</th>
<th>MTB-200</th>
<th>G-BOND</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bluephase</td>
<td>23.2 (± 2.0)a</td>
<td>19.4 (± 2.9)bcd</td>
</tr>
<tr>
<td>VALO</td>
<td>20.4 (± 1.9)bcd</td>
<td>18.5 (± 1.8)bc</td>
</tr>
<tr>
<td>Curing Unit 2.500</td>
<td>20.6 (± 1.7)b</td>
<td>18.1 (± 1.9)b</td>
</tr>
</tbody>
</table>

Conclusions: The tested hypothesis was partially accepted since microshear bond strength varied according to adhesive type and was affected by curing unit only when Scotchbond Universal Adhesive was used.

3M ESPE Summary

Aim of Study: To assess whether different curing lights will have a significant impact on the shear bond strengths of self-etch adhesives to enamel.

Summary of Results: Only slight changes were noted for adhesion values using the different lights for curing.
Scotchbond™ Universal Adhesive (EXL 759)

Effect of Layers of Bonding System on Dentin Bond Strength

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Objectives: It is known and accepted that using more than two layers of dentin bonding agents increases bond strength. The purpose of this study was to evaluate the effect of additional layers of bonding systems on the bond strength to dentin.

Methods: 36 recently extracted caries and restoration free upper premolars, were cut and polished with 600 grit until superficial dentin was exposed. Teeth were divided into three groups to receive dentin bonding systems: ProtecBond (Kuraray), Adper™ Single Bond 2 Adhesive (3M ESPE) and an experimental one bottle no-etch bonding agent. For each bonding system three sub-groups were made (n = 4) to receive 2, 3 and 4 layers of bonding adhesive, all placed according to manufacturer’s instructions. Composite Z100™ (3M ESPE) was placed over the bonding agent and 1mm 2 sticks were created from all teeth. 20 randomly selected sticks from each group were selected to be evaluated in Microtensile at 0.1 cm/minute until failure. Data was recorded in MPa and evaluated with a two-way ANOVA. Scheffe’s test for comparison among number of layers and bonding systems was also calculated at 0.05 significance level.

Results: Means with standard deviations (in parenthesis) are shown in table. The experimental dentin bonding system was the only one that did not increase its bond strength to dentin with additional layers. ANOVA and Scheffe’s test showed a significance difference between the bond strength with two and four layers, for all bonding systems. No difference was found among adhesives.

<table>
<thead>
<tr>
<th></th>
<th>Adper Single Bond 2 Adhesive</th>
<th>Adhesive EXL 759</th>
<th>Protec Bond</th>
</tr>
</thead>
<tbody>
<tr>
<td>2 layers</td>
<td>22.4 (2.4)</td>
<td>32.4 (9.0)</td>
<td>29.0 (7.1)</td>
</tr>
<tr>
<td>3 layers</td>
<td>35.5 (11.7)</td>
<td>26.0 (5.8)</td>
<td>30.1 (9.5)</td>
</tr>
<tr>
<td>4 layers</td>
<td>38.2 (6.6)</td>
<td>25.3 (9.5)</td>
<td>36.8 (7.6)</td>
</tr>
</tbody>
</table>

Conclusions: The use of additional layers affects the bond strength of the system to dentin, but it may be a positive or negative effect depending on the bonding system.

3M ESPE Summary

Aim of Study: To determine if applying additional layers of the adhesive would increase bond strength for Scotchbond Universal Adhesive.

Summary of Results: Applying additional layers of adhesive did not increase the bond strength for Scotchbond Universal Adhesive. For this study, two layers provided the highest bond strength.

Results found in abstracts for Scotchbond™ Universal Adhesive also apply to products registered under the following names: Scotchbond Universal Adhesive and Adhesive EXL 759.

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http://iadr.confex.com/iadr/2012tampa/webprogram/
Scotchbond™ Universal Adhesive (EXL 759)

Bonding Durability of All-In-One Adhesive Systems Under Thermocycled Repeated-Load

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Objectives: The purpose of this study was to examine the bonding durability of three recent all-in-one adhesive systems, two latest experimental one-bottle one-step system; EXL 759 (EXL, 3M ESPE) and MTB200 (MTB, KURARAY) and a popular systems on the market; Adper Easy Bond (EB, 3M ESPE), as compared with that of a two-bottle two-step self-etching primer system; Clearfil SE Bond (SE, control, KURARAY).

Methods: Standardized V-shaped cavity was prepared in the cervical region of 80 extracted human premolars. The cavities were pretreated with the four systems (20 each) and then restored clinically according to the manufacturer’s instructions. Half of the restored specimens (10 each system) were subjected to thermo-mechanical repeated stress condition simulating intra-oral environment; thermocycling (5ºC/55ºC × 2,000 sets) and simultaneous repeated-load (12kgf × 105 times). The other half of specimens were supplied as non-stress control group. Micro-tensile bond strengths (μ-TBS) to the gingival dentin wall of the specimens with and without the stress load were measured. The data of μ-TBS were examined using ANOVA, Tukey’s q-test and Student’s t-test.

Results: The mean μ-TBS (SD) in MPa of the specimens with/without the stress load were EXL; 21.7 (3.7)/23.3 (3.9), MTB; 21.1 (3.2)/22.2 (5.0), EB; 26.9 (8.4)/27.8 (5.0), SE; 14.8 (5.5)/22.0 (5.7). The μ-TBS of three recent all-in-one adhesive systems with the stress were significantly greater than that of SE at p < 0.01, the values without stress were similar to or greater than the value of SE. The mode of the stress did not influence the μ-TBS of recent all-in-one systems, but had effect upon the μ-TBS of SE.

Conclusions: The bonding durability, based on the μ-TBS with and without a stress simulating intra-oral environment, of the three recent all-in-one adhesive systems was superior to that of SE. Two latest experimental all-in-one systems; EXL and MTB, demonstrated excellent bonding durability that could maintain the μ-TBS even under the stress condition.

3M ESPE Summary

Aim of Study: To determine the durability of the bond for Scotchbond™ Universal Adhesive and Adper™ Easy Bond adhesive compared to Clearfil SE Bond after thermocycling and load stressing.

Summary of Results: Scotchbond Universal Adhesive and Adper Easy Bond showed good durability compared to Clearfil SE Bond.

Results found in abstracts for Scotchbond™ Universal Adhesive also apply to products registered under the following names:
Single Bond Universal Adhesive and Adhesive EXL 759.

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http://iadrc.confex.com/iadr/2012tampa/webprogram/
Scotchbond™ Universal Adhesive (EXL 759)

Bonding Performance of Recent All-In-One Adhesive Systems to Abrasion-Lesion Dentin

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Objectives: The purpose of this study was to examine the bonding performance of recent all-in-one adhesive systems to cervical abrasion lesion dentin in comparison with the surfaces of cervical sound enamel and dentin.

Methods: Four recent all-in-one adhesive systems, two latest experimental systems; EXL 759 (EXL, 3M ESPE) and MTB200 (MTB, Kuraray) and two systems on the market; Adper™ Easy Bond Adhesive (AEB, 3M ESPE) and Clearfil Tri-S Bond (CTS, Kuraray) and a popular self-etching primer system; Clearfil SE Bond (CSE, Kuraray, for control) were used. The exposed dentin surface of cervical abrasion lesion (AD) of 25 extracted human premolars was cleaned with a polishing brush and water. Standardized V-shaped cavity with a bevel at occlusal enamel was prepared in the buccocervical region of 25 extracted human premolars. The surface of AD and the surfaces of beveled sound enamel (SE) and gingival sound dentin wall (SD) of the standardized cavity were pretreated clinically with the five systems according to the manufacturer’s instructions. The immediate tensile bond strength (ITBS) of each system to AD, SE and SD were measured (n = 5) with a custom-made portable adhesion tester (JDR 75, 1996). The data were statistically analyzed using ANOVA, Tukey’s q-test and Student’s t-test.

Results: The mean ITBS (SD) in MPa to AD/SE/SD were EXL; 23.7 (5.1)/24.0 (5.8)/24.3 (5.9), MTB; 24.4 (6.0)/22.9 (5.2)/24.6 (5.5), AEB; 22.3 (6.3)/23.5 (5.3)/26.0 (6.1), CTS; 17.5 (3.8)/22.0 (6.5)/24.4 (4.4), CSE; 21.5 (4.4)/22.7 (3.2)/24.9 (5.3). There were no differences in the ITBS among five systems, regardless of the difference in tooth surface. The ITBS of TSB to AD was significantly smaller than the value to SD at p < 0.05, no differences in the ITBS of other systems among three tooth surfaces were recognized.

Conclusions: The bonding performance of recent all-in-one adhesive systems to cervical abrasion lesion dentin was equivalent to that to the surfaces of sound enamel and dentin. In addition the systems could obtain clinically acceptable ITBS that was similar to SEB.

3M ESPE Summary

Aim of Study: To determine the immediate tensile bond strength of Scotchbond Universal Adhesive and Adper Easy Bond Adhesive to cervical abrasion lesion dentin compared to sound cervical dentin and enamel.

Summary of Results: There was no difference in bond strength to abrasion lesion dentin or the sound dentin and enamel for both Scotchbond Universal Adhesive and Adper Easy Bond Adhesive.
Scotchbond™ Universal Adhesive

Pre-Etching Dentin Effects on Morphology and Bond Strength of Self-Etching Adhesives

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Objectives: A new versatile all-in-one self-etch adhesive system has been developed to combine total-etch and self-etch features. The objective was to evaluate the tensile bond strength (μTBS) and interface bond morphology of self-etching adhesives on phosphoric acid pre-etched dentin surface.

Methods: Ten extracted human molars were ground to obtain a flat dentin surface and polished with 600-grit SiC paper. The specimens were randomly divided into five groups: (G1) Scotchbond Universal Adhesive – SU (3M ESPE); (G2) pre-etched SU; (G3) Adper™ Easy Bond Adhesive – EB (3M ESPE); (G4) pre-etched EB; and (G5) Adper Single Bond Plus – SB (3M-ESPE). Pre-etching specimens were conditioned with 35% phosphoric acid (PA) for 15 seconds. All adhesives were applied according to manufacturer’s instructions and composite resin crowns were incrementally built up. After 24 hours, 0.8mm² beams were obtained and tested to μTBS. In order to observe dentin-adhesive interface, selected beams from each group were stained with 0.1% Rodhamine B for 1 hour and analyzed using Confocal Laser Scanning Microscopy (CLSM). Data were analyzed using ANOVA and Fisher’s PLSD test (= 0.05).

Results: No statistical difference was observed among the groups (P > 0.05): G1 = 46.96 (18.7) MPa; G2 = 44.14 (13.7) MPa; G3 = 42.72 (13.8) MPa; G4 = 41.59 (13.6) MPa; and G5 = 40.74 (12.0) MPa.

Conclusions: Pre-etching dentin using PA did not affect μTBS values of one-step self-etching adhesives. The resin-dentin bond interface thickness of self-etching adhesives increased on pre-etched dentin approach.

3M ESPE Summary

Aim of Study: To evaluate the bond strengths and dentin/adhesive interface for Scotchbond Universal Adhesive to etched and self-etched dentin compared to separate conventional total-etch and self-etch adhesive systems.

Summary of Results: Scotchbond Universal Adhesive provided for consistent bond strengths in both the self-etch and total-etch modes to dentin when compared to the conventional separate adhesive systems. The hybrid layer formations were also consistent in comparison to the conventional self-etch or total-etch systems.
Scotchbond™ Universal Adhesive

A New Universal Simplified Adhesive: 6-Month Clinical Evaluation

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Objectives: A 6-month randomized, controlled prospective study evaluated the clinical performance of Scotchbond Universal Adhesive (3M ESPE) in non-carious cervical lesions (NCCL).

Methods: Thirty-nine patients, with at least four similar sized NCCL participated in this study. After sample size calculation, 200 restorations were placed, according to one of the following groups: TE-Dry: total-etch plus dry dentin; TE-Moist: total-etch plus moist dentin; SE: self-etch; SE-En: selective enamel etching plus self-etch. The restorations were placed incrementally using a composite resin (Filtek™ Supreme Ultra Universal Restorative/3M ESPE). The restorations were evaluated at baseline and after 6 months according to both the FDI criteria (Hickel et al., J Adhes Dent 2007) and the classical USPHS criteria. Statistical analyses were performed with Friedman repeated measures analysis of variance by rank and Wilcoxon sign-ranked test for significance in each pair (alpha = 0.05).

Results: Only 4 restorations (SE: 3 and TE-Moist: 1) were lost after 6 months (not statistically significant for either criteria). Marginal discoloration occurred in one restoration in SE group (not statistically significant for either criteria). The percentage of bravo scores for marginal adaptation at 6 months were 36%, 32%, 46% and 42% for TE-Dry, TE-Moist, SE and SE-En groups, respectively, for FDI criteria (not statistically significant). However, 194/200 restorations were scored as alpha for marginal adaptation using the USPHS criteria (one bravo for SE and one bravo for SE-En, not statistically significant).

Conclusions: All groups showed acceptable clinical retention rates and fulfilled the ADA partial acceptance criteria for dental bonding systems in NCCL. FDI criteria were more sensitive for identifying differences in adhesive restoration of NCCL.

3M ESPE Summary

Aim of Study: To evaluate the clinical performance of Scotchbond Universal Adhesive when used in the various modes of etching and moisture levels.

Summary of Results: Scotchbond Universal Adhesive provided acceptable clinical acceptance for all modes evaluated at the 6-month time frame.
Impact of Contrast Ratio on Photo-Cure Depth of Low-Stress Composites

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Objectives: Successful photo-curing of dental composites depends on many factors including the composition and light source. Clinicians desire deeper curing preparations in order to reduce steps and save time. Photo-curing of large composites, however, is typically limited by insufficient light transmission in the composite resulting in limited depth of cure (DOC) coupled with undesirable polymerization shrinkage-stress. Several recent commercial composites claim low stress polymerization with 4+mm DOC. The aim of this study was to investigate the impact of contrast ratio (CR) on the DOC of five experimental low-shrinkage-stress composites.

Methods: Five experimental dental composite compositions with CR’s between 40 and 70 were prepared by adding an opacifying pigment to a base photo-polymerizable composition (35% resin and 65% filler, by weight). Specimens (1mm thick x 30mm diameter, n = 3) of each composition were cured for 20 seconds at an irradiance 750mW/cm² and the CR’s were determined using a Hunter UltraScan SE Spectrophotometer with a 1” aperture. DOC specimens (n = 3) for each composition were evaluated per ISO 4049 using a 20 seconds cure with an LED (550mW/cm²@455nm peak output).

Results: A plot of CR versus DOC fit an exponential model: \( y = 9.78e^{-0.018x} \), where \( y = \text{DOC (mm)}, x = \text{CR} \) and \( B = \text{fit constant (R}^2 = 0.98) \). Table 1 summarizes the materials, their respective CR, DOC and standard deviations.

Table 1

<table>
<thead>
<tr>
<th>Material</th>
<th>Contrast Ratio (n = 3)</th>
<th>Depth of Cure (mm) (n = 3)</th>
</tr>
</thead>
<tbody>
<tr>
<td>EXP1</td>
<td>39.84 (0.61)</td>
<td>4.793 (0.160)</td>
</tr>
<tr>
<td>EXP2</td>
<td>48.65 (0.15)</td>
<td>3.985 (0.109)</td>
</tr>
<tr>
<td>EXP3</td>
<td>56.06 (0.42)</td>
<td>3.477 (0.055)</td>
</tr>
<tr>
<td>EXP4</td>
<td>62.55 (0.08)</td>
<td>2.992 (0.062)</td>
</tr>
<tr>
<td>EXP5</td>
<td>69.93 (0.35)</td>
<td>2.809 (0.081)</td>
</tr>
</tbody>
</table>

Conclusions: The data demonstrates that DOC decreases exponentially as the CR increases for this model low-stress composite system. This relationship between composite depth of cure and light transmission indicates the importance of having adequate light availability at the 4+mm depths to ensure sufficient deep curing. Several examples of commercialized materials will also be presented.

3M ESPE Summary

Aim of Study: This study examined the curing properties of an experimental bulk fill flowable and specifically the relationship between opacity as defined by contrast ratio and depth of cure as determined via ISO 4049 Depth of cure.

Summary of Results: Adjusting contrast ratio provides a strategy to increase the depth of cure of esthetic light-cure composite materials. These results show that it is feasible to increase the depth of cure by decreasing the composites opacity while at the same time maintaining the exposure conditions (intensity and time) similar to those recommended for traditional composites.
# Stickiness and Stringiness of Uncured Nano and Nano-Hybrid Composites

**T.D. DUNBAR, B.D. CRAIG, G.A. KOBUSSEN and J.L. KITTELSON, MS 260-2B-12, 3M ESPE, Maplewood, MN**

## Objectives:
This study measured the stickiness of selected uncured resin-composites, comparing one nano-composite (NC) to four nano-hybrids (NH). The tendency to string while handled was also examined. This study also sought to obtain a correlation between measured stickiness parameters and the composite’s tendency to string.

## Methods:
Stickiness was analyzed utilizing a texture analyzer. A stainless steel probe was pushed into composite at constant force for a given contact time and withdrawn at a given rate. During withdrawal, the maximum tensile force (Fmax) exerted on the probe and the Work (area under the force-distance curve) were measured. Data (n = 4/group) was collected at 37°C and two combinations of contact time and removal speed (1s and 8mm/second, or 20 seconds and 1mm/second).

Stringiness was assessed by handling each composite with a dental instrument, ranking them on a scale of 1 (least stringy) to 4 (most stringy). Filtek™ Supreme Ultra Universal Restorative (FSU), Estelite® Sigma Quick (ESQ), Gradia Direct X (GDX), Paradigm™ Nano Hybrid Restorative (PNH) and TPH®3 (TPH3) were examined.

## Results:

<table>
<thead>
<tr>
<th>Composite Type</th>
<th>Fmax(N) 1s, 8mm/second</th>
<th>Fmax(N) 20s, 1mm/second</th>
<th>Work(N-mm) 1s, 8mm/second</th>
<th>Work(N-mm) 20s, 1mm/second</th>
<th>Stringiness</th>
</tr>
</thead>
<tbody>
<tr>
<td>FSU</td>
<td>1.6 ± 0.3</td>
<td>1.1 ± 0.2</td>
<td>0.8 ± 0.2</td>
<td>0.7 ± 0.2</td>
<td>NC 1</td>
</tr>
<tr>
<td>ESQ</td>
<td>6.49 ± 0.08</td>
<td>5.13 ± 0.2</td>
<td>14 ± 2</td>
<td>7.8 ± 0.2</td>
<td>NH 3</td>
</tr>
<tr>
<td>GDX</td>
<td>5.3 ± 0.6</td>
<td>3.0 ± 0.3</td>
<td>6.3 ± 0.6</td>
<td>3.1 ± 0.6</td>
<td>NH 3</td>
</tr>
<tr>
<td>PNH</td>
<td>2.1 ± 0.4</td>
<td>1.36 ± 0.06</td>
<td>1.2 ± 0.3</td>
<td>1.15 ± 0.15</td>
<td>NH 2</td>
</tr>
<tr>
<td>TPH3</td>
<td>4.9 ± 1.3</td>
<td>4.1 ± 0.5</td>
<td>30 ± 7</td>
<td>8.4 ± 0.2</td>
<td>NH 4</td>
</tr>
</tbody>
</table>

Superscript indicates samples that were statistically different from FSU using the 2-sample t-test and p < 0.05. Work and Fmax were evaluated by linear regression for their correlation with instrument stringiness rating at either condition. Work correlated best with stringiness, $R^2 = 71\%$ for 1 second and 8mm/second and $R^2 = 73\%$ for 20 seconds and 1mm/second.

## Conclusions:
The texture analyzer measurement of Fmax and Work indicated that FSU was less than or equal to in stickiness for all composites examined. This work aids the dental practitioner by quantifying composite stickiness.

## 3M ESPE Summary

**Aim of Study:** Using a texture analyzer, this study examined the stickiness of the nanocomposite, Filtek Supreme Ultra Universal Restorative and four nano-hybrid composites. An assessment of the stringiness of the composites was also made by tactile examination with a dental instrument.

**Summary of Results:** Stickiness of Filtek Supreme Ultra Universal Restorative as measured by the texture analyzer was lower than all except one of the nano-hybrid composites. The work of stickiness was shown to be a potential predictor of stringiness as experienced by the clinician.
Filtek™ Bulk Fill Flowable Restorative

Novel Bulk-Fill Flowable with Excellent Mechanical and Wear Properties


Objectives: To compare the curing stress, compressive strength (CS), diametral tensile strength (DTS) and wear properties of a 3M experimental Bulk-fill low-stress flowable with some other commercially available Bulk-fill flowable materials.

Methods: Materials used were an experimental Bulk-fill flowable material from 3M ESPE, Filtek™ Supreme Ultra Flowable (3M ESPE), Grandio® SO Heavy Flow (Voco), SureFil® SDR™ flow (Dentsply) and Venus® Bulk Fill (Heraeus). Curing stress was measured with an Aluminum cusp deflection method, expressed by microns of deflection after 1 minute of light cure. Compressive Strength and Diametral Tensile Strength were measured using cylindrical samples. Wear data were recorded as decreases in sample depth after 200,000 rotational cycles using a three-body-wear apparatus.

Results: The curing stress of different materials is listed in the bar chart below.

The properties measured are summarized in the following table, with p values vs. the experimental flowable included.

<table>
<thead>
<tr>
<th>Materials</th>
<th>Compressive Strength (MPa)</th>
<th>Diametral tensile Strength (MPa)</th>
<th>Wear (µm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Experimental 3M flowable</td>
<td>349.9 (8.8)</td>
<td>70.3 (10.3)</td>
<td>14.7 (0.55)</td>
</tr>
<tr>
<td>SureFil SDR flow</td>
<td>222.9 (5.3)</td>
<td>48.7 (5.7)</td>
<td>24.6 (0.66)</td>
</tr>
<tr>
<td>Venus Bulk Fill</td>
<td>317.7 (16.1)</td>
<td>59.3 (7.5)</td>
<td>21.7 (1.00)</td>
</tr>
</tbody>
</table>

Conclusions: The new 3M experimental bulk-fill flowable material had similar stress level during cure when compared with current low stress flowables on the market. It showed statistically higher compressive strength and better wear properties compared with SureFil SDR Flow and Venus Bulk Fill. Its diametral tensile strength was also statistically higher than SDR Flow.

continued on next page >
Filtek™ Bulk Fill Flowable Restorative (cont.)

3M ESPE Summary

**Aim of Study:** This study examined various physical properties of Filtek™ Bulk Fill Flowable Restorative in comparison to other bulk-fill flowable restoratives and representative traditional flowables. Polymerization stress was also examined indirectly by means of a tooth deflection model.

**Summary of Results:** The simulated tooth deflection measured for Filtek Bulk Fill Flowable Restorative was similar to the other bulk fill flowable restoratives and less than that of traditional flowables. Filtek Bulk Fill Restorative also showed very favorable physical properties and a wear rate lower than the other bulk fill flowables.
Cure Depth Confirmation of Novel Bulk-Fill Flowable Composite

G. KOBUSSEN1, C. CAO1, A. EIGNER2, J. OXMAN1, M. DORUFF1, R. HALVORSON1, F. LAPLANT2, J.L. KITTELSON1 and S. BIGHAM1, 13M ESPE, St. Paul, MN, 13M Corporate Research Analytical Lab, St. Paul, MN

Objectives: The objective of this research was to confirm that a novel bulk-fill flowable composite was sufficiently cured at a target depth of 4mm. Sufficient cure was defined as equivalent cure to Filtek™ Supreme Ultra Flowable Restorative (FSUF) at its claimed depth of 2mm.

Methods: The experimental material was shaded at 2 levels, a lightly pigmented shade, designated EXP-U and an A2 shade, designated EXP-A2. Comparisons were made to FSUF-A2 shade. The cure conditions, defined by time and light intensity, are outlined in the table below.

<table>
<thead>
<tr>
<th>Material — Light Intensity</th>
<th>Targeted Depth/Cure Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>FSUF-A2 — 550mW/cm²</td>
<td>2mm/20s</td>
</tr>
<tr>
<td>EXP-A2 — 550mW/cm²</td>
<td>4mm/40s</td>
</tr>
<tr>
<td>EXP-U — 550mW/cm²</td>
<td>4mm/20s</td>
</tr>
<tr>
<td>FSUF-A2 — 1W/cm²</td>
<td>2mm/10s</td>
</tr>
<tr>
<td>EXP-A2 — 1W/cm²</td>
<td>4mm/20s</td>
</tr>
<tr>
<td>EXP-U — 1W/cm²</td>
<td>4mm/10s</td>
</tr>
</tbody>
</table>

The targeted 4mm depth of cure was confirmed by the following methods:

Depth of cure: Depth of cure was measured per ISO4049:2009, 7.10.

Knoop Hardness: A sample was prepared that was a cylinder bisected along the height (hemicylindrical) to give a flat surface. The sample was cured from one end of the hemicylinder. Knoop hardness was measured as a function of depth (distance from light). The hardness at the targeted cure depth was then ratioed to the maximum hardness.

Degree of Conversion: Raman spectroscopy was used to determine degree of conversion (DC) as a function of depth. A hemicylindrical sample was prepared. Measurements were taken in an array of 0.3 x 0.3mm pixels (7 pixels wide past the targeted cure depth). The area of the 1636 and 1608 cm⁻¹ bands for cured (polymer) and uncured (monomer) were ratioed to calculate degree of conversion using the following equation.

\[
DC = 100 - \left( \frac{\text{Area}_{1636}/\text{Area}_{1608} \text{ polymer}}{\text{Area}_{1636}/\text{Area}_{1608} \text{ monomer}} \right) \times 100
\]

The DC at the target cure depth was then ratioed to the maximum conversion.

Adhesion: Adhesion to bovine dentin and enamel was measured by wire-loop methodology using a composite button of targeted cure depth.

continued on next page >
Results: Mean values and p-values vs. FSUF are given in the tables below.

<table>
<thead>
<tr>
<th>Material — Light Intensity</th>
<th>Depth of Cure</th>
<th>Knoop Hardness % Max.</th>
<th>DC % Max</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean (St Dev)</td>
<td>Targeted Depth/Cure Time</td>
<td>Mean (St Dev)</td>
</tr>
<tr>
<td>FSUF-A2 – 550mW/cm²</td>
<td>2.72 (0.028)</td>
<td>2mm/20s</td>
<td>86.0% (5.8%)</td>
</tr>
<tr>
<td>EXP-A2 – 550mW/cm²</td>
<td>4.29 (0.118)</td>
<td>4mm/40s</td>
<td>82.9% (2.6%)</td>
</tr>
<tr>
<td>EXP-U – 550mW/cm²</td>
<td>4.93 (0.044)</td>
<td>4mm/20s</td>
<td>86.9% (3.8%)</td>
</tr>
<tr>
<td>FSUF-A2 – 1W/cm²</td>
<td>2.63 (0.034)</td>
<td>2mm/10s</td>
<td>83.2% (5.9%)</td>
</tr>
<tr>
<td>EXP-A2 – 1W/cm²</td>
<td>4.16 (0.118)</td>
<td>4mm/20s</td>
<td>79.0% (4.0%)</td>
</tr>
<tr>
<td>EXP-U – 1W/cm²</td>
<td>4.66 (0.078)</td>
<td>4mm/10s</td>
<td>83.1% (2.9%)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Material — Light Intensity</th>
<th>Wire Loop Adhesion</th>
<th>Dentin</th>
<th>Wire Loop Adhesion</th>
<th>Enamel</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean (SD)</td>
<td>P-Value vs. FSUF</td>
<td>Mean (SD)</td>
<td>P-Value vs. FSUF</td>
</tr>
<tr>
<td>FSUF-A2 – 550mW/cm²</td>
<td>17.10 (3.50)</td>
<td>—</td>
<td>13.94 (5.16)</td>
<td>—</td>
</tr>
<tr>
<td>EXP-A2 – 550mW/cm²</td>
<td>20.21 (5.92)</td>
<td>.352</td>
<td>18.09 (2.15)</td>
<td>.158</td>
</tr>
</tbody>
</table>

Single™ Bond Plus Adhesive — EXP-A2 (4mm button), FSUF-A2 (2mm button)

Conclusions: The novel bulk-fill flowable composite exhibited statistically equivalent cure at a depth of 4mm as compared to FSUF at 2mm.

3M ESPE Summary

Aim of Study: ISO 4049 Depth of Cure, Knoop Hardness and Raman spectroscopy were utilized to characterize the extent of cure throughout Filtek™ Bulk Fill Flowable Restorative.

Summary of Results: Under the recommended exposure conditions for this product, the depth of cure as measured per ISO 4049 was found to be greater than 4mm. Normalized Knoop hardness measured at 4mm from the surface was determined to be 79% or greater while the normalized conversion at this depth was observed to be 88% or greater. The normalized Knoop and degree of conversion values at 4mm for Filtek Bulk Fill Flowable Restorative were equivalent to the traditional flowable examined at a depth of 2mm.
Effect of Exposure Time and Distance on Composite Cure

M. DORUFF1, G. KOBUSSEN1, B. HOLMES3, R. HALVORSON1, J. OXMAN1, C. CAO1, A. EIGNER3, F. LAPLANT3 and S. BIGHAM1, 13M ESPE, St. Paul, MN; 3M ESPE Dental Products, Maplewood, MN; 3M Corporate Research Analytical Lab, St. Paul, MN

Objectives: This study examines the impact high intensity LED light exposure for 10 second or less and the effect of distance from the restorative surface on the degree of conversion (DC) of a nanocomposite.

Methods: Samples of Filtek Supreme Ultra Universal Restorative (FSU), A2B (n = 3) were cured from one end of the specimen using an LED light (1130mW/cm²) in a semi-cylindrical stainless steel mold (3mm diameter X 10mm) for 3, 4, 5, 6 and 10 seconds with the light guide in contact with the nanocomposite surface. The procedure was replicated with the light guide held 5mm and 10mm above the surface for 10 second exposure.

The DC on the flat side of each specimen was assessed using Raman microscopy. A DC map was created by taking the ratio of the 1635-1608cm⁻¹ Raman bands at each 0.3 x 0.3mm pixel across the flat surface according to the formula:

\[ DC = 100 - \left( \frac{Area_{1636}}{Area_{1608}} \right) \times 100 \]

The 7 DC measurements at each 0.3mm distance from the illuminated surface were averaged and normalized to the DC at 0mm.

Results: Tukey’s pairwise comparison was used to determine differences (p < .05) between exposure times (Table I). Equivalent values are noted with superscripts.

<table>
<thead>
<tr>
<th>Depth</th>
<th>3 seconds</th>
<th>4 seconds</th>
<th>5 seconds</th>
<th>6 seconds</th>
<th>10 seconds</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>1.0ab</td>
<td>1.0ab</td>
<td>1.0ab</td>
<td>1.0abc</td>
<td>1.0abc</td>
</tr>
<tr>
<td>0.3</td>
<td>0.97a</td>
<td>0.95a</td>
<td>1.1b</td>
<td>0.98c</td>
<td>0.98c</td>
</tr>
<tr>
<td>0.6</td>
<td>0.92a</td>
<td>0.93a</td>
<td>1.06</td>
<td>0.96c</td>
<td>0.96c</td>
</tr>
<tr>
<td>0.9</td>
<td>0.86a</td>
<td>0.85a</td>
<td>1.03</td>
<td>0.93b</td>
<td>0.93b</td>
</tr>
<tr>
<td>1.2</td>
<td>0.77a</td>
<td>0.78a</td>
<td>0.97</td>
<td>0.90c</td>
<td>0.90c</td>
</tr>
<tr>
<td>1.5</td>
<td>0.70a</td>
<td>0.68a</td>
<td>0.9</td>
<td>0.86c</td>
<td>0.86c</td>
</tr>
<tr>
<td>1.8</td>
<td>0.6b</td>
<td>0.59b</td>
<td>0.84</td>
<td>0.81b</td>
<td>0.81b</td>
</tr>
<tr>
<td>2.1</td>
<td>0.52a</td>
<td>0.48a</td>
<td>0.71</td>
<td>0.73b</td>
<td>0.73b</td>
</tr>
<tr>
<td>2.4</td>
<td>0.39a</td>
<td>0.41a</td>
<td>0.62</td>
<td>0.65c</td>
<td>0.65c</td>
</tr>
<tr>
<td>2.7</td>
<td>0.27a</td>
<td>0.29a</td>
<td>0.48</td>
<td>0.57c</td>
<td>0.57c</td>
</tr>
<tr>
<td>3.0</td>
<td>na</td>
<td>0.19</td>
<td>0.37</td>
<td>0.46c</td>
<td>0.46c</td>
</tr>
</tbody>
</table>

continued on next page >
Dunnett’s comparison was used to compare the 5 and 10mm distance data to the 0mm offset data (Table II). In all cases the data was statistically lower when the light was held 5mm or more above the composite surface. The resulting DC means were normalized to 0 depth DC.

Table II. Comparison of Relative DC as a function of depth and light guide distance from sample surface.

<table>
<thead>
<tr>
<th>Depth (mm)</th>
<th>0mm Offset</th>
<th>5mm Offset</th>
<th>10mm Offset</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>1.00</td>
<td>1.00</td>
<td>1.00</td>
</tr>
<tr>
<td>0.3</td>
<td>0.98</td>
<td>0.97</td>
<td>0.96</td>
</tr>
<tr>
<td>0.6</td>
<td>0.97</td>
<td>0.96</td>
<td>0.94</td>
</tr>
<tr>
<td>0.9</td>
<td>0.95</td>
<td>0.89</td>
<td>0.87</td>
</tr>
<tr>
<td>1.2</td>
<td>0.94</td>
<td>0.86</td>
<td>0.80</td>
</tr>
<tr>
<td>1.5</td>
<td>0.89</td>
<td>0.80</td>
<td>0.71</td>
</tr>
<tr>
<td>1.8</td>
<td>0.82</td>
<td>0.70</td>
<td>0.61</td>
</tr>
<tr>
<td>2.1</td>
<td>0.77</td>
<td>0.60</td>
<td>0.51</td>
</tr>
<tr>
<td>2.4</td>
<td>0.68</td>
<td>0.48</td>
<td>0.40</td>
</tr>
<tr>
<td>2.7</td>
<td>0.60</td>
<td>0.38</td>
<td>0.29</td>
</tr>
<tr>
<td>3.0</td>
<td>0.48</td>
<td>0.31</td>
<td>0.24</td>
</tr>
</tbody>
</table>

Conclusions: Shortening cure times to less than 10 seconds significantly impacts the degree of conversion especially when the light source is not in direct contact with the composite surface.

3M ESPE Summary

Aim of Study: This study examined the depth-dependent degree of conversion of Filtek™ Supreme Ultra Universal Restorative cured with a high intensity LED curing light (1130mW/cm²) for curing times between 3 and 10 seconds and with the end of the light guide positioned at 0, 5 and 10mm above the sample.

Summary of Results: At a 10-second cure time, with the light guide in direct contact with the sample, the measured conversion at 2mm within the material was approximately 80% of the maximum value measured. The relative conversion value decreased with shorter cure times and at greater distance of the light guide to the sample.
Filtek™ Silorane Low Shrink Posterior Restorative

Three-Year Clinical Performance of Low-Shrinkage Resin Composite Restorations

F.T. BURKE, Dental School, University of Birmingham, Birmingham, United Kingdom and R. CRISP, School of Dentistry, University of Birmingham, Cheshire, United Kingdom

Objectives: To evaluate the clinical performance, at three years, of load-bearing restorations formed in Filtek Silorane™ Resin Composite (3M ESPE, Seefeld, Germany), in patients attending five UK dental practices.

Methods: Five members of the PREP Panel — a practice-based research group of general dental practitioners in the UK and Ireland, participated. Ethical approval was obtained. Each practitioner placed 25 class I or II restorations formed in Filtek Silorane™ Low Shrink Restorative (3M ESPE, Seefeld, Germany) resin composite, where indicated on posterior teeth. The restorations were reviewed by one independent examiner along with the practitioner who placed the restorations at three years +/- 3 months, using modified USPHS criteria.

Results: 98 restorations (83% recall), of mean age 37.5 months in 60 patients were examined. Of the 98 restorations, 30 were Class I and 68 were Class II, with 22 restorations involving the replacement of one or more cusps. All restorations were present, with 79% rated optimal for marginal integrity and one rated unacceptable. 51% of the restorations were rated optimal for marginal discoloration. In cases where the marginal discoloration was not optimal, an estimate was made of the % of the length of the margin which was discoloured: this was a mean of 12%. 100% of the restorations were rated optimal for color match. Surface staining was noted in 3 restorations. 92% of the restorations were rated optimal for surface quality and 95% were rated optimal for anatomic form.

Conclusions: The results of this study indicate that Class I and Class II restorations of Filtek Silorane Low Shrink Restorative, placed in patients attending five UK general dental practices, are performing satisfactorily after 3 years.

Acknowledgments: Thanks are due to the participating practitioners and their patients and to 3M ESPE for financial support.

Disclosures: Dr. Burke is a member of 3M ESPE’s Scientific Advisory Board but has no financial interest in the company.

3M ESPE Summary

Aim of Study: Objective of study was to investigate the Class I and II performance of Filtek Silorane Low Shrink Posterior Restorative as placed in a practice-based research group.

Summary of Results: 98 restorations with a mean service life of 37.5 months were examined. One restoration was rated unacceptable for marginal integrity. 51% of the restorations were rated optimal for margin discoloration. Marginal discoloration, when present, was observed to include on average 12% of the total marginal length. 100, 92 and 95% of the restorations were rated optimum for color match, surface quality and anatomic form respectively. Authors concluded that Filtek Silorane Low Shrink Restorative is performing satisfactorily after 3 years.
Partial Caries Removal in Superficial Dentin: Two Years of Follow-Up
J.T. PEREIRA, E. LUCAS, L. BERNARDI and F. ARAÚJO, Pediatric Dentistry, Universidade Federal do Rio Grande do Sul, Porto Alegre, Brazil

Objectives: The objective of this randomized clinical trial was to evaluate the clinical and radiographic outcomes of the partial caries removal technique in superficial dentin of occlusal lesions in primary molars.

Methods: Forty-nine primary molars with cavitated superficial occlusal caries, with no preoperative signs and symptoms of irreversible pulpitis, were restored with a composite resin (Filtek™ P90 Low Shrink Posterior Restorative, 3M ESPE). The teeth were randomly divided into two groups according to the caries removal technique: (1) total caries removal — TCR and (2) partial caries removal — PCR. These teeth were evaluated clinically and radiographically for two years.

Results: After 2 years, 41 teeth concluded the study being 16 of test group (PCR) and 19 of control group (TCR). 93.75% (15/16) of teeth treated with PCR and 94.73% (18/19) of teeth treated with TCR presented a successful outcome, as determined by clinical and radiographic examination. Restoration fracture and the progression of the caries lesion under the restoration were the signs of treatment failure. When evaluating only the radiographic outcome, one tooth of TCR group presented progression of the caries lesion under the restoration. Of the two teeth diagnosed from clinical and radiographic examination as a failure, one of each group, none presented signs and symptoms of interradicular and/or periapical lesion, being capable of restorative repair.

Conclusions: This study demonstrates that the technique of partial caries removal in superficial dentin of occlusal cavities in primary molars results in similar clinical and radiographic two-year outcomes as compared to the conventional total caries removal technique. It’s important to consider that partial caries removal in superficial dentin, besides being a most conservative technique may dispense the use of local anesthesia improving the professional-patient relationship.

3M ESPE Summary

Aim of Study: This study investigated the performance of Filtek P90 Low Shrink Posterior Restorative in primary teeth prepared for occlusal restorations in cavities in which caries were either totally or partially removed.

Summary of Results: After 2 years, 16 teeth prepared with total caries removal and 19 teeth with partial caries removal were examined via clinical and radiographic analysis. One restoration of each group exhibited restoration fracture with progressive caries under the lesion. These restorations were determined to be repairable. The remaining teeth presented a successful outcome.
Clinical Performance of Silorane-Based Composite Resin in Class II Restorations

F.S. GONÇALVES, C.D.L. CASTRO, A.B.D.A. FREITAS, A.C. BUENO, A.N. MOREIRA and C.S. MAGALHÃES, Restorative Dentistry, Universidade Federal de Minas Gerais, Belo Horizonte, Brazil

Objectives: The aim of this randomized, double-blind, controlled study was to compare the clinical performance of a silorane-based composite resin with a methacrylate-based composite resin in Class II restorations, after 18-month follow-up.

Methods: After obtaining informed consent, 33 patients received 100 direct Class II composite-resin restorations (n = 50) that were randomly allocated into a test group (Filtek™ P90 Low Shrink Posterior Restorative/Adhesive System — 3M ESPE) or control group (Filtek P60 Posterior Restorative/Adper™ SE Plus — 3M ESPE). After one week, the restorations were finished and polished. A single operator performed all the restorative procedures. Two calibrated examiners (weight kappa ≥ 0.7) assessed the restorations at the baseline and after 18 months, according to modified United States Public Health System (USPHS) criteria. The parameters analyzed were marginal discoloration, marginal integrity, surface texture, anatomic form, postoperative sensitivity, secondary caries, proximal contact and radiographic aspect. Data were analyzed with Mann-Whitney U-test, Wilcoxon signed Rank, Kaplan-Meier statistics and Cox regression analysis (p < 0.05).

Results: At 18-month follow-up, 90% of the restorations were evaluated. No significant difference was observed between the materials at baseline or after 18 months (p > 0.05). The analysis of each material over the time showed significant difference in the control group for marginal discoloration (p = 0.046) and surface texture (p = 0.005). For the test group, there was significant difference for marginal discoloration (p = 0.025), marginal integrity (p = 0.046) and surface texture (p = 0.005). Similar survival rates were observed for the test (92%) and the control (98%) groups (p = 0.168). There was no significant effect of the restorative system (p = 0.233), the tooth type (p = 0.668) nor the number of restored surfaces (p = 0.377) on the survival curves.

Conclusions: The clinical performance of silorane-based composite resin was similar to the well-known methacrylate systems. The restorations lost quality but remained acceptable after 18 months. The silorane resin system is acceptable to restore Class II cavities.

This abstract is based on research that was funded entirely or partially by an outside source: CNPq 474679/2009-8; FAPEMIG CDS-APQ-01606-09

3M ESPE Summary

Aim of Study: This study presented the 18-month performance of Filtek P90 Low Shrink Posterior Restorative (Filtek™ Silorane Low Shrink Posterior Restorative) in Class II restorations as measured via modified USPHS criteria and compared to Filtek P60 Posterior Restorative bonded with a self-etch adhesive.

Summary of Results: 90 restorations were available for recall at 18 months. No significant difference was noted between the two materials at baseline or at 18 months. Survival rates for the test and control groups were 92% and 98% respectively. The authors noted that the silorane resin system is acceptable as a Class II restorative material.

Results found in abstracts for Filtek™ Silorane Low Shrink Posterior Restorative System also apply to Filtek™ P90 Low Shrink Posterior Restorative and Filtek™ LS Low Shrink Posterior Restorative System.

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http://iadr.confex.com/iadr/2012rio/webprogram/, 2012
Clinical Performance of Nanohybrid/Nanofill Posterior Composite Restoration — 6-Month Evaluation

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Objectives: This study relates the preliminary results of a clinical performance of Nanohybrid and Nanofill composites in restorations Class I and II after six months.

Methods: Fifteen patients, each with three molars affected by primary caries or the need to replace restorations, were enrolled in this evaluation from February to November of 2011. Two operators placed the 57 Class I and 18 Class II restorations according to the manufacturers’ instructions (n = 25/group). The teeth were restored with a nanofill composite and a 2-step adhesive system (Filtek Z350 XT Universal Restorative + Adper™ Single Bond 2/3M ESPE), a nanofill composite and self etch adhesive system with enamel acid conditioning (Filtek Z350 XT Universal Restorative + Adper™ Easy One Self-Etch Adhesive) and a nanohybrid composite and a 2-step adhesive system (Charisma Opal + Gluma). Two independent examiners made all evaluations according to the USPHS modified Ryge criteria immediately after placement of restorations and at December 2011 recall visit.

Results: The mean of evaluation time was six months and both recall rate and survival rate were 100%. No participants reported postoperative sensitivity symptoms and all restorations were classified with alpha score.

Conclusions: The nanohybrid and nanofill composite materials performed satisfactorily in posterior restoration over the 6-month observation period.

This abstract is based on research that was funded entirely or partially by an outside source: Sao Paulo Research Foundation — FAPESP; grant 2010/18575-1

3M ESPE Summary

Aim of Study: This study reports the six-month performance of Class I and II restorations made using the nanocomposite Filtek Z350 XT Universal Restorative and bonded with either the total-etch adhesive Adper Single Bond 2 Adhesive or Adper Easy One Self-Etch Adhesive. A nano-hybrid, Charisma Opal, bonded using a 2-step total etch adhesive was also investigated.

Summary of Results: 25 restorations of each of the three groups placed among 15 patients were available at the six month recall. All restorations were scored alpha for all USPHS modified Ryge criteria. There were no differences among the three treatment groups.
Silorane-Based Composite in Class I Restorations: A Split-Mouth Clinical Trial

C.D.L. CASTRO, F.S. GONÇALVES, A. BUENO, A.B.D.A. FREITAS, A.N. MOREIRA and C.S. MAGALHÃES, Restorative Dentistry, Universidade Federal de Minas Gerais, Belo Horizonte, Brazil

Objectives: The aim of this split-mouth, double-blind clinical trial was to compare the performance of a silorane-based composite-resin with a methacrylate-based composite-resin in Class I restorations, after 1-year follow-up.

Methods: This study received approval from the local ethics committee. After obtaining the informed consent, the subjects (n = 35) received at least one pair of restorations, which were randomly allocated into test (Filtek™ P90 Low Shrink Restorative/P90 Adhesive System, 3M ESPE) and control (Filtek™ P60 Posterior Restorative/Adper™ SE Plus Self-Etch Adhesive, 3M ESPE) groups. A single operator performed all the restorations, following the clinical protocols and manufacturer’s instructions. After one week, they were finished, polished and independently assessed by two trained examiners (weight kappa ≥ 0.7) using modified United States Public Health System criteria. After one year, the same examiners reassessed the restorations. Wilcoxon test compared the frequencies of Alpha (A), Bravo (B) and Charlie (C) scores in test and control groups and between baseline and one-year recall.

Results: All patients were present at baseline and 31 patients (88.6%) returned at recall. The frequencies (%) of restorations scored A/B/C at baseline, for test and control groups were, respectively: Marginal Discoloration (100/0/0), (100/0/0); Marginal Integrity (97.1/2.9/0), (100/0/0); Surface Texture (100/0/0), (100/0/0); Anatomic Contour (94.3/5.7/0), (100/0/0); Postoperative Sensitivity (97.2/2.8/0), (97.2/2.8/0); Recurrent Caries (100/0/0), (100/0/0). At recall, frequencies (%) of A/B/C, for test and control groups were, respectively: Marginal Discoloration (100/0/0), (100/0/0); Marginal Integrity (93.6/6.4/0), (100/0/0); Surface Texture (96.8/3.2/0), (87.1/12.9/0); Anatomic Contour (100/0/0), (100/0/0); Postoperative Sensitivity (96.8/3.2/0), (100/0/0); Recurrent Caries (100/0/0), (100/0/0). No statistically significant differences were found between groups at baseline and at recall (p > 0.05). No significant differences were found when each group was compared through time (p > 0.05).

Conclusions: The clinical performance of silorane-based composite-resin proved similar to that achieved with methacrylate resin. A silorane-based composite-resin could be a promising alternative for Class I restorations.

This abstract is based on research that was funded entirely or partially by an outside source: CNPQ — Conselho Nacional de Desenvolvimento Científico e Tecnológico (Edital MCT/CNPQ14/2009) 474679/2009-8 and FAPEMIG — Fundação de Amparo à Pesquisa do estado de Minas Gerais (Edital 01/2009 Â– DEMANDA UNIVERSAL) CDS-APQ-01606-09

3M ESPE Summary

Aim of Study: The aim of this study was to investigate the clinical performance of Filtek Silorane Low Shrink Posterior Restorative in Class I restorations using Filtek P60 Posterior Restorative as the control.

Summary of Results: No difference in performance as measured by modified USPHS criteria were noted between the materials at either baseline or at the one-year recall of 31 matched pair restorations.
Lone-Term Stability of Silorane-Based Composite Resin Used as Core Build-Up

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Objectives: Core build-ups are part of the prosthodontic treatment. Esthetic dentistry demands the use of composite resins to fabricate a core build-up. The objective of this retrospective study was to assess long-term durability of core build-ups fabricated with composite resin in one dental practice.

Methods: One thousand one hundred and forty records were reviewed. A total of 282 core build-ups were fabricated in a period of 4 years with a low-shrinking composite resin (Filtek™ LS, 3M ESPE). Both endodontically treated and vital teeth received composite resin build-ups as part of the prosthodontic treatment. Vital teeth were filled before preparation for complete crowns. Most endodontically treated teeth received a fiber post (RelyX™ Fiber Post, 3M ESPE) that were cemented with a self-adhesive resin cement (RelyX™ Unicem Self-Adhesive Resin Cement and RelyX™ Unicem 2 Automix Self-Adhesive Resin Cement, 3M ESPE). Twenty-three endodontically treated teeth did not receive a post. Twenty-one endodontically treated teeth had a wide canal and therefore posts were customized with a composite resin. Metal-free restorations made with a zirconia-based substructure (Lava™, 3M ESPE) and a lithium disilicate restoration (E-max, Ivoclar Vivadent) and were cement with a self-adhesive resin cement (RelyX™ Unicem Self-Adhesive Resin Cement and RelyX™ Unicem 2 Automix Self-Adhesive Resin Cement, 3M ESPE). Patients were in evaluated every 6 months on periodontal maintenance.

Results: After a period of 4 years, only one tooth failed. A maxillary lateral incisor crown and post became loose. The root was not fractured and both the canal and the post were cleaned and the crown together with the post were re-cemented.

Conclusions: Within the limitations of this study, it can be concluded that after 4 years, core build-ups made with a low-shrinking composite resin performed extremely well. A low-shrinking composite resin may be used as core build-ups successfully.

3M ESPE Summary

Aim of Study: This retrospective study analyzed the performance of Filtek™ P90 Low Shrink Restorative (Filtek™ Silorane Low Shrink Posterior Restorative) as a core build-up in 282 vital and non-vital teeth (unspecified) receiving either Lava™ Crowns or E-max crowns (non-specified) and cemented with a self-adhesive resin cement. Most endodontically treated teeth received a fiber post cemented with a self-adhesive cement.

Summary of Results: After four years, one restoration failed due to adhesive failure between the fiber post/build-up and the tooth. No other failures were reported for the remaining 282 restorations. It was concluded that Filtek™ P90 was performing “extremely well” as a core material.
Filtek™ Supreme Ultra Universal Restorative

Quantitative Comparison of Opalescence and Haze of Translucent Universal Composites

B. CRAIG, J.D. OXMAN, W.S. BIGHAM, J.L. KITTELSON and R.W. HALVORSON, 3M ESPE, Saint Paul, MN

Objectives: The objective of this work was to compare the relative optical properties, such as opalescence and transmissive haze, which are important aesthetic properties for commercially available composites utilized on the incisal edges of composite restorations. From reported literature values of human enamel, an opalescence value of 22.9 (± 1.9) would be seen as matching natural dentition and lower haze materials should have better transmissivity of light in the incisal edge.

Methods: Incisal, clear, or translucent shades of 7 different universal composite materials were cured into 1mm discs and compared in 3 replicate measurements for optical properties including opalescence (Cab) and optical haze utilizing a Hunter Spectrophotometer. Filtek™ Supreme Ultra Universal Restorative (Clear-Translucent), Herculite™ Ultra (Light Incisal), Charisma™ (Clear Opal), Estelite™ Sigma Quick (Clear Enamel), Esthet-X™ HD (Clear Enamel), Tetric™ EvoCeram (Translucent) and Empress™ Direct (Tran 20) were evaluated.

Results: The table below summarizes the results.

<table>
<thead>
<tr>
<th>Material</th>
<th>Shade</th>
<th>Measured Opalescence (Cab)</th>
<th>Standard Deviation of Opalescence</th>
<th>Measured Transmissive Haze (%)</th>
<th>Standard Deviation of Haze</th>
</tr>
</thead>
<tbody>
<tr>
<td>Filtek™ Supreme Ultra</td>
<td>Clear-Translucent</td>
<td>21.89</td>
<td>.21</td>
<td>55.09</td>
<td>.50</td>
</tr>
<tr>
<td>Herculite™ Ultra</td>
<td>Light Incisal</td>
<td>19.31</td>
<td>.39</td>
<td>93.14</td>
<td>.07</td>
</tr>
<tr>
<td>Charisma™</td>
<td>Clear Opal</td>
<td>24.22</td>
<td>.15</td>
<td>87.36</td>
<td>.07</td>
</tr>
<tr>
<td>Estelite™ Sigma Quick</td>
<td>Clear Enamel</td>
<td>9.82</td>
<td>.02</td>
<td>98.92</td>
<td>.04</td>
</tr>
<tr>
<td>Esthet-X™ HD</td>
<td>Clear Enamel</td>
<td>17.29</td>
<td>.09</td>
<td>81.31</td>
<td>.29</td>
</tr>
<tr>
<td>Tetric™ EvoCeram</td>
<td>Translucent</td>
<td>10.61</td>
<td>.09</td>
<td>96.70</td>
<td>.03</td>
</tr>
<tr>
<td>Empress™ Direct</td>
<td>Tran 20</td>
<td>10.50</td>
<td>.06</td>
<td>91.62</td>
<td>.32</td>
</tr>
</tbody>
</table>

Conclusions: Through statistical analysis (ANOVA, pairwise t-test, p < 0.05) of the responses, the Filtek Supreme Ultra Universal Restorative and Charisma™ materials showed opalescence equivalent to that previously reported for human enamel, whereas the other materials were statistically lower. Filtek™ Supreme Ultra Universal Restorative had statistically lower haze than any of the other measured composites. Some interesting microstructural and optical properties of the nanocomposite may be the cause of this unique behavior and will be discussed.

3M ESPE Summary

Aim of Study: The objective was to investigate the opalescence and percent transmissive haze ($T_{\text{trans}}/T_{\text{total}} \times 100$) of incisal or clear shades of several composite brands.

Summary of Results: Filtek Supreme Ultra Universal Restorative was observed to exhibit opalescence similar to published values for human enamel. It also exhibited the least transmissive haze of all the materials investigated.
Objectives: To compare the diametral tensile strength (DTS) of four high-viscosity GICs with and without exposure to a heating source during their setting period.

Methods: Sixty specimens of 6.0mm (diameter) and 3.0mm (height) were prepared for each material (KM = Ketac™ Molar Easymix, 3M ESPE; F9 = Fuji 9 Gold Label, GC Int; ChF = Chemfil Rock, Dentsply/DeTrey and EQUIA system, GC Int). Samples were made according to ADA specification 27. Capsules were mixed for 10 seconds whereas hand-mix cements were inserted into plastic capsules after being mixed and injected by syringe. Assemblies were placed into stainless steel moulds, previously coated with solid vaseline. Samples of each material were equally divided into three groups: a) Setting without heating; b) Heated for 20 seconds with a LED curing light with a power of 800mW; c) Heated for 20 seconds with a LED curing light with a power of 1,400mW. DTS test was performed after 1 day of storage using a Universal Testing Machine (Digimess) at a cross-head speed of 0.5mm/minute. DTS [kgf/cm²]. Values were calculated as follows: DTS = 2L/p dh (L=load at fracture [kgf], p = 3.14, d = diameter of the samples [cm] and h = height of the samples [cm]) and converted into MPa. Data was subjected to two-way analysis of variance (ANOVA) and Bonferroni test (p < 0.05).

Results: Significant differences were found in all materials when heated with LED 1,400mW compared to no-heating. No statistical differences were found in F9 between 800 and 1,400mW and in ChF between no-heating and 800mW. The four GICs reached their highest DTS values when heated with a power of 1,400mW. EQUIA obtained the highest DTS mean (SD) values in the three groups: 9.96 (0.66), 10.79 (0.96), 13.35 (1.12)MPa respectively.

Conclusions: Application of LED during setting of high-viscosity GICs increases their DTS improving early physical-mechanical properties.

3M ESPE Summary

Aim of Study: To compare the diametral tensile strength of Ketac Molar Easymix and other 3 commercially available GICs with and without exposure to a heating source during setting period.

Summary of Results: The four GICs reached their highest DTS values when heated with LED 1,400mW compared to no-heating.
A new resin-modified glass-ionomer (RMGI) restorative material (Ketac™ Nano Quick Mix, 3M ESPE) with nano-technology has been recently introduced in a quick-mix capsule system that does not require trituration.

Objectives: To compare the physical properties of various RMGI and conventional glass-ionomer restorative materials: Ketac Nano Quick Mix (3M ESPE), Ketac™ Nano Paste-Paste (3M ESPE), Fuji II LC (GC), Fuji Filling LC (GC) and Ketac Fill (GC).

Methods: Compressive strength, flexural strength/modulus, fracture toughness and percent porosity were examined. Ten specimens were fabricated per group. For compressive strength testing, cylindrical specimens were prepared in a 6mm thick x 4mm diameter stainless-steel mold, light cured all sides (Bluephase 16i, Ivoclar) for 20 seconds each, stored 24-hours at 37°C/95% humidity and loaded to failure in a universal testing machine (MTS). For flexural strength/modulus and fracture toughness testing, rectangular beam and single-edge notched specimens were created in a 2 x 2 x 25mm mold (1mm preformed notch — fracture toughness), light cured in five over-lapping segments per side, stored as before and tested in 3-point flexure. Flexural modulus was determined from the slope of the linear region of the load-deflection curve. For percent porosity of closed pores, specimens were created in a 2mm thick x 8mm diameter stainless-steel mold, scanned with a microtomographic unit (Skyscan 1172) and analyzed with software (CT Analyzer, Skyscan). A mean and standard deviation were determined per group. See table below. A 1-way ANOVA/Tukey was performed per property (alpha = 0.05).

Results: Except for percent porosity, significant differences were found between groups per property (p < 0.001).

Conclusions: Compared to the other glass-ionomer restorative materials, the new quick-mix capsule Ketac Nano Quick Mix had high strength properties and low flexural modulus with no significant increase in porosity.

<table>
<thead>
<tr>
<th>Restorative Material</th>
<th>Physical Property Mean (std dev)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Compressive Strength (MPa)</td>
</tr>
<tr>
<td>Ketac Nano Quick-Mix (RMGI, encapsulated)</td>
<td>96.06 (8.57)a</td>
</tr>
<tr>
<td>Ketac Nano Paste-Paste (RMGI, hand mixed)</td>
<td>84.77 (22.13)ab</td>
</tr>
<tr>
<td>Fuji II LC (RMGI, encapsulated)</td>
<td>97.14 (10.01)c</td>
</tr>
<tr>
<td>Fuji Filling LC (RMGI, hand mixed)</td>
<td>69.40 (5.11)c</td>
</tr>
<tr>
<td>Ketac Fill (GI, encapsulated)</td>
<td>54.50 (12.37)c</td>
</tr>
</tbody>
</table>

Groups with the same letter per column are not significantly different (p > 0.05)
Ketac™ Nano Light-Curing Glass Ionomer Restorative (cont.)

3M ESPE Summary

**Aim of Study:** To compare the physical properties of Ketac™ Nano Quick Mix vs. conventional and resin-modified glass-ionomer restorative materials.

**Summary of Results:** Compared to the other glass-ionomer restorative materials, Ketac Nano Quick Mix had high strength properties and low flexural modulus with no significant increase in porosity.
**Ketac™ Nano Light-Curing Glass Ionomer Restorative**

**Nanofilled RMGI: Fracture Toughness, Surface Roughness and Gloss Testing**

J. PALASUK, S. CHO, J. PLATT and W. BROWNING, Indiana University School of Dentistry, Indianapolis, IN

**Objectives:** Fracture toughness, roughness and gloss were compared in a nano-ionomer (NGI), two conventional glass ionomers (CGI), a resin-modified glass ionomer (RMGI), a compomer (CMP) and a microhybrid composite (MHy).

**Methods:** Compared were: 1) Ketac™ Nano (KN); 2) Esthet-X (EX); 3) Geristore (GS); 4) Photac™ Fil (PF); 5) Ketac™ Fil Plus (KF); and Fuji IX (F9). A three-point bending test (MTS Sintech Renew) was used to test fracture toughness. Gloss units (GU) were measured; (Gloss Checker, Model IG 331, Horiba). Roughness (Ra; μm) was measured (Taylor Hobson Surtronic 3+). Ra and GU specimens were measured three times.

**Results:** For fracture toughness (MPa·m1/2) results were: EX = 2.1; GS = 1.4; KN = 1.1; PF = 0.9; KF = 0.5; and F9 = 0.5. Results of statistical testing, from highest to lowest were: EX > GS > KN > PF > KF = F9 (ANOVA; p < 0.001; except KF vs. F9; p = 0.30). GU results were: EX = 8.3; GS = 3.8; KN = 5.9; PF = 1.3; KF = 0.0; and F9 = 1.4. Statistically, highest to lowest: EX > KN > GS > PF = F9 > KF (p < 0.001; except PF vs. F9; p = 0.36). Ra (μm): EX = 0.09; GS = 0.38; KN = 0.24; PF = 0.74; KF = 1.58; and F9 = 0.66. Statistically, lowest to highest: EX < KN < GS < F9 < PF < KF (p < 0.001; except PF vs. F9; p = 0.35. Ra & GU, Mixed model ANOVA).

**Conclusions:** Within the limitation of this in vitro experiment, it may be concluded that: Relative to the two CGIs and the RMGI, the addition of nanofillers appears to result in higher fracture toughness, higher gloss and lower surface roughness.

**3M ESPE Summary**

**Aim of Study:** To compare the fracture toughness, roughness and gloss between Ketac Nano and conventional glass-ionomers, RMGI and compomer.

**Summary of Results:** Ketac Nano yielded higher fracture toughness, higher gloss and lower surface roughness. This might be explained by the presence of the nanofillers.
Ketac™ Molar

Clinical Performance of Glass-Ionomer Sealants in High Caries-Risk Children

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Objectives: To evaluate the clinical performance of two conventional glass-ionomer sealants in high caries-risk children.

Methods: Using a single-blind split-mouth randomized design, 413 sealants were applied on sound permanent first molars of 112 children (6–8 years old) after parental consent. Ketac™ Molar (3M ESPE) and Maxxion® (FGM) were applied respectively on 195 and 218 teeth by “press finger technique” in a school environment. Teeth were evaluated at 6-, 12-, 18-, 24-month intervals with regard to retention and caries development. The same calibrated dentist performed the baseline and follow-up examinations under natural light, using CPI probes and mirrors, after tooth brushing and gauze-drying (Kappa > 0.84). Clinical success was determined by the absence of caries development. Data was performed for survival analysis using Kaplan-Meier and Log-Rank Tests (p < 0.05).

Results: After 24 months, 284 (69%) sealants of 88 children were evaluated, 139 with Ketac Molar and 145 with Maxxion. There were 12% of Ketac Molar and 8% of Maxxion fully and partially retained sealants. Of the original sealed surfaces 78% of Ketac Molar and 87% of Maxxion were totally lost without caries development. While 10% of Ketac Molar and 5% of Maxxion were lost with caries development. There was no significant difference between the survival times for the two sealants (p = 0.46). The probability of cumulative survival rate was 99% (95% Confidential Interval = 97.9%–100%) that was the same for both materials.

Conclusions: The clinical performance of the two glass-ionomer sealants was considered satisfactory with a high preventive caries effect within 24 months. Although the sealants placed according to the ART approach showed low retention rates, this approach seems to be appropriate for high caries-risk children.

This abstract is based on research that was funded entirely or partially by an outside source: CNPQ

3M ESPE Summary

Aim of Study: To evaluate the performance of Ketac Molar as glass-ionomer sealants in high caries-risk children.

Summary of Results: After 24 months, 12% of the 139 restorations with Ketac Molar sealant were fully or partially retained, 78% were totally lost without caries development and 10% totally lost with caries development. Although the sealants placed according to the ART approach showed low retention rates, this approach seems to be appropriate for high caries-risk children.
Controlling RMGIC Properties by Delayed Light-Curing

M. GERMAN, F. ABDUL-FATAH, M. ZEGLAM and R. WASSELL, School of Dental Sciences, Newcastle University, Newcastle-upon-Tyne, United Kingdom

Objectives: To control the setting reactions in RMGICs so that fluoride release and strength are optimized for use as a restoration.

Methods: RMGICs Fuji-II-LC (FLC), which sets by acid-base reaction (AB) and light-activated polymerization (LP) and Vitremer (VT), which sets by AB, LP and chemically-activated polymerization (CP), a composite (Z250) and a GIC (Fuji IX, FIX) were selected. Four RMGIC groups were defined, [A] specimens were light-cured for 20 seconds immediately after mixing, [B] specimens were placed in a light-proof bag in a dark room for 10-minutes before light curing, [C] like [B] but left for 60 minutes before light curing and [D] like B but left for 24 hours and not light cured. The composite and GIC were handled as per manufacturers’ instructions.

The extent of the polymerization was measured using ATR-FTIR (ratio of peaks at 1638/1712 cm⁻¹ (C = C/C-O) n = 5). Fluoride release (n = 5) was measured over 30 days using ion-selective electrodes and the compressive and diametral strengths (n = 5) were measured after 1 and 30 days storage in DI water at 37°C.

Results: The setting of FLC and VT differed over time, resulting in significant differences in performance. Both materials showed a degree of conversion of around 48% for group [A], however, as time post-mix increased, the CP of VT specimens resulted in an increase in polymerization in these specimens and less AB. The FIX specimens had the greatest fluoride release at day-1 but later group [D] specimens showed comparable levels. Per group, VT specimens released more fluoride than FLC. FLC specimens were stronger than VT specimens for all groups, although significantly weaker than the Filtek™ Z250 Restorative specimens.

Conclusions: Significant changes in fluoride release and strength can be achieved by controlling the setting reaction but the properties are still some way below GICs for fluoride release and composites for strength.

<table>
<thead>
<tr>
<th>Material</th>
<th>Fluoride (ppm)</th>
<th>Compressive Strength (MPa)</th>
<th>Diametral Strength (MPa)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean (SD)</td>
<td>Mean (SD)</td>
<td>Mean (SD)</td>
</tr>
<tr>
<td></td>
<td>Day 1</td>
<td>Day 30</td>
<td>Day 1</td>
</tr>
<tr>
<td>FLC</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A</td>
<td>15 (0.6)</td>
<td>2 (0.1)</td>
<td>150 (8)</td>
</tr>
<tr>
<td>B</td>
<td>12 (1.6)</td>
<td>2 (0.2)</td>
<td>161 (9)</td>
</tr>
<tr>
<td>C</td>
<td>21 (5.9)</td>
<td>2 (0.5)</td>
<td>147 (10)</td>
</tr>
<tr>
<td>D</td>
<td>31 (2.9)</td>
<td>6 (1.1)</td>
<td>102 (6)</td>
</tr>
<tr>
<td>VT</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A</td>
<td>21 (1.7)</td>
<td>2 (0.3)</td>
<td>111 (14)</td>
</tr>
<tr>
<td>B</td>
<td>35 (4.2)</td>
<td>2 (0.2)</td>
<td>125 (10)</td>
</tr>
<tr>
<td>C</td>
<td>34 (3.3)</td>
<td>2 (0.1)</td>
<td>119 (9)</td>
</tr>
<tr>
<td>D</td>
<td>33 (3.0)</td>
<td>5 (1.8)</td>
<td>107 (6)</td>
</tr>
<tr>
<td>Z250</td>
<td>n/a</td>
<td>n/a</td>
<td>313 (17)</td>
</tr>
<tr>
<td>FIX</td>
<td>70 (3.8)</td>
<td>4 (0.4)</td>
<td>136 (37)</td>
</tr>
</tbody>
</table>

n/a = not measured

continued on next page >
3M ESPE Summary

**Aim of Study:** To control the setting reactions in Vitremer so that fluoride release and strength are optimized for use as a restoration.

**Summary of Results:** Vitremer group [B] specimens showed the highest fluoride release in Day 1 and group [D] specimens in Day 30. The highest compressive strength was measured in group [A] specimens after 30 days and the diametral strength in was comparable in specimens [A], [B] and [C] in Day 1 and Day 30.
Survival of ART Sealants in High Caries-Risk Peruvian Community

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Objectives: Evaluate the survival rate and preventive capacity of high viscosity glass ionomer cement (GIC) sealants placed according to the Atraumatic Restorative Treatment (ART) approach in first permanent molars in children from 6 to 12 years old, in a high caries-risk community.

Methods: A sample of 75 first permanent molars from 34 children with an informed consent between 6 and 12 years of age from the school Jose Olaya in Bujama, Lima-Peru; were selected for the study. The sealants were applied by one operator trained in a “hands-on” ART Workshop, developed during 5 days by the IADR Peruvian Division. The permanent first molars that presented deep pits and fissures were sealed following the guidelines of the ART approach with a high viscosity GIC (Ketac™ Molar Easymix, 3M ESPE).

Results: The sealants were evaluated after 12 months using the WHO criteria. From the initial 34 children 9 changed to other school (drop-out rate: 26.67%). 56.4% were code 0 (Present, good seal); 23.6% code 1 (Present partly, pits and/or fissures are free of caries); 1.8% code 2 (Present partly, pits and/or fissures with signs of active caries) and 18.2% code 3 (Not present, pits and/or fissures show no signs of active caries). The complete or partial retention of the sealants was 81.82%, however, in spite of the clinical lost of the sealants, 98.18% of the originally sealed teeth remain caries-free. There was also a statistically significant difference (p < 0.05) in regard of the teeth location; sealants completely present were found in higher proportions in inferior first molars (67.9%) when compared with superior first molars (44.4%).

Conclusions: The ART sealants have shown good potential to prevent dental caries in a high caries-risk group after 12 months of following.

3M ESPE Summary

Aim of Study: To evaluate the survival rate and preventive capacity of Ketac Molar Easymix when used as a sealant according to ART approach in first permanent molars in children from 6 to 12 years old in high caries-risk community.

Summary of Results: After 12 months 56.4% were present with a good seal, 23.6% present partially free of caries, 1.8% present partially with signs of caries and 18.2% not present and no signs of caries. In spite of the clinical loss of the sealants, 98.18% of the originally sealed teeth remained caries-free. Sealants completely present were found in higher proportions in inferior first molars (67.9%) when compared with superior first molars (44.4%).
Ketac™ Molar

Restorations in Molars Affected by Molar Incisor Hypomineralization: Longitudinal Study

J.F. SOUZA¹, F. JEREMIAS², C.M. COSTA-SILVA³, A.C.C. ZUANON⁴, L. SANTOS PINTO² and R.D.C.L. CORDEIRO², ¹Clinica Infantil, Universidade Est. Paulista Julio Mesquita, Araraquara-SP, Brazil, ²Universidade Est. Paulista Julio Mesquita, Araraquara, Brazil, ³Department of Community Dentistry, Division of Health Education and Health Promotion, Faculdade de Odontologia de Piracicaba, Universidade de Campinas – UNICAMP, Araraquara, Brazil, ⁴Pediatric Dentistry and Orthodontic Department, Universidade Est. Paulista Julio Mesquita, Araraquara, Brazil

Objectives: To evaluate the integrity of Glass Ionomer Cement (GIC) restoration in permanent first molars (PFM) affected by MIH.

Methods: It was selected 43 PFM with MIH of the 25 children aged 6–9 years classified, according the severity of the MIH lesion (European Academy of Paediatric Dentistry/EAPD, 2003). The PFMs should be fully erupted and with restorative treatment needed. The PFMs were restored with GIC (Ketac™ Molar Easymix, 3M ESPE, St. Paul, EUA), according to the manufacturers’ instructions. Evaluations were performed at baseline, 6, 12 and 18 months for anatomic form, marginal adaptation, retention, secondary caries and presence of plaque. Restoration survival was estimated by Kaplan-Meier test and evaluated using log-rank tests (p < 0.05) and Cox regression model.

Results: The affected surfaces were occlusal (50%), buccal (28%), lingual (12%), mesial (6%) and distal (4%). Caries associated with MIH occurred in 40.8% of the PFM. Severe defects with enamel surface breakdown occurred in 51.3%, demarcated opacities in 27.7%, and unacceptable restoration in 15.7%. The success rate of the occlusal restoration was 70.2%. The major failure rate occurred at 12 months (14.3%). The Kaplan-Meier survival analysis showed that the presence of plaque and caries did not increase significantly the restoration failure risk (p = 0.06 and p = 0.41, respectively). The severity of the MIH lesions did not influence the failure risk (p = 0.27). The risk of failure was 6.76 times greater in the PFMs with plaque.

Conclusions: The GIC restorations presented high success rate, preserving the integrity of hypomineralized molars.

3M ESPE Summary

Aim of Study: To evaluate the performance of Ketac Molar Easymix in permanent first molars affected by MIH.

Summary of Results: Ketac Molar Easymix performed well, preserving the integrity of the hypomineralized molars.
Vitremer™ Core Buildup-Restorative

Antimicrobial Efficacy of Glass Ionomer Cement

J.B. SOUZA, C.O. SILVA, L.G. LOPES, C. ESTRELA and C.R.A. ESTRELA, Universidade Federal De Goias, Goiânia, Brazil

**Objectives:** To assess the antimicrobial activity of three commercially available glass ionomer cements (Vitremer, Maxxion R and Vidrion R).

**Methods:** The antimicrobial effectiveness was assessed by means of agar diffusion method in Petri plates with 20ml of BHIA previously inoculated with 0.1mL of biological indicator (Streptococcus mutans — ATCC 25175) and then maintained in adequate atmosphere for 48 hours. Microbial inhibition zones, indicative of effectiveness of the tested materials, were measured using a digital caliper with a resolution of 0.01mm, after 24 and 48 hours.

**Results:** The Maxxion R cement was effective on the analyzed bacteria, in 24 as in 48 hours, establishing different growth inhibition areas. The Vitremer cement showed antimicrobial activity only after 48 hours while the Vidrion R did not promote inhibition zone. Among the products tested, the largest inhibition halo was observed for the Vitremer cement.

**Conclusions:** The Vitremer and Maxxion R cements showed antimicrobial activity against Streptococcus mutans.

3M ESPE Summary

**Aim of Study:** To assess the antimicrobial activity of Vitremer by means of agar diffusion method in Petri plates inoculated with S Mutans.

**Summary of Results:** Vitremer showed antimicrobial activity only after 48 hours, but generated the largest inhibition zone.
Clinical Evaluation of Resin-Modified Ionomer Cement on Primary Molars

S.M. MACIEL¹, V.D. OLIVEIRA², A.L. RAMOS², M.L.C. FRACASSO¹ and M.G.A. PROVENZANO¹, ¹Universidade Estadual De Maringa, Londrina, Brazil, ²Universidade Estadual De Maringa, Maringá, Brazil

Objectives: To evaluate the caries-preventive effect of a resin-modified glass-ionomer cement (RMGIC) (Vitremer) used as occlusal sealant application on occlusal surfaces of primary molars after 6 and 12 months after placement.

Methods: In a sample of 30 children aged 24 to 60 months the maxillary right and mandibular left primary molars were sealed with the RMGIC (G2) while their antagonists were not sealed (G1 — control group). Six and twelve months after sealant placement, the sealants were assessed by two previously calibrated examiners. Were considered: retention, presence of secondary caries and marginal staining. In addition, the mean oral hygiene index (OHI) and the caries index (dmf-t) were assessed. Data were analyzed statistically by the Fischer’s exact test at a significance level of 5%.

Results: From a total of 58 teeth, 96.3% were caries free. After 6 and 12 months, the sealant with total or partial retention were of 94.64% and 90.4% respectively, but without an evident relationship between the sealant/control groups and dental caries. There was association between dmf-t and sealer’s marginal staining and OHI (P < 0.05). Occlusal sealing was effective with respect to caries prevention and showed satisfactory retention as far as partial retention is considered. The OHI satisfactory showed no decay. At 12 months, it was found that the teeth were not sealed association with dental caries (P < 0.05).

Conclusions: It was concluded that teeth sealing of occlusal RMGIC had preventive effect because there was clear relationship between the groups sealant and control tooth decay.

3M ESPE Summary

Aim of Study: To evaluate the efficacy of Vitremer when used as sealant in primary molars.

Summary of Results: Occlusal sealing was effective with respect to caries prevention and showed satisfactory retention as far as partial retention is considered.
Clinical Evaluation of Glass Ionomers in Class V Carious Lesions

A.I. ABDALLA, Department of Restorative Dentistry, Faculty of Dentistry, Tanta University, Tanta, Egypt

Objectives: The aim of this study was to evaluate the clinical performance of three LC GIC materials: Ionolux (VOCO, Cuxhaven, Germany), GC Fuji II LC (GC Europe, Belgium) and Ketac™ Nano Light-Curing Glass Ionomer Restorative (3M ESPE) in class V carious lesions after three years.

Methods: Forty-six patients with at least 2 Class V lesions were enrolled in this study. A total of 175 Class V carious lesions having the gingival margins extending into cementum were restored with the tested materials. A calibrated operator placed the restorations according to each manufacturer’s instruction. The restorations were finished with super fine diamond point and polished with Soflex™ Discs (3M ESPE). Two independent examiners evaluated the restorations at baseline, after 1 year, two years and three years according to the modified USPHS criteria. The differences between tested materials were statistically evaluated by Pearson Chi-Square test (p = 0.05).

Results: After three years, 131 restorations were available for evaluation (Recall Rate = 74.8%). One Ionolux restoration was lost after three years while four restorations of Fuji II LC and five restorations of Ketac Nano were lost (retention rate 92%).

Conclusions: After three years, limited deterioration in marginal adaptation and slight surface roughness were detected for Ionolux restorations. In contrast Fuji II LC and Ketac Nano showed significant deterioration in some of tested criteria. The clinical performance of all tested materials was clinically acceptable.

3M ESPE Summary

Aim of Study: To evaluate the clinical performance of Ketac Nano over 3 years in class V carious lesions.

Summary of Results: Ketac Nano Light-Curing Glass Ionomer Restorative showed acceptable clinical performance similar to Fuji II LC.
Effect of Curing Light and Restoration Location on Energy Delivery

S. BHATT¹, C.D. AYER², R. PRICE², R.D. PERRY³ and C. FELIX²,¹ Tufts University, Boston, MA, ²Dental Clinical Sciences, Dalhousie University, Halifax, NS, Canada

Objectives: This study determined how long it would take skilled operators to deliver 16J/cm² to an anterior or a posterior restoration using different light curing units (LCUs).

Methods: Two skilled operators used the following LCUs at two locations in the MARC-patient simulator (BlueLight analytics): Optilux 501 (Kerr) standard mode for 20 seconds, Sapphire (Den-Mat) for 5 seconds, Elipar S10 LED Curing Light (3M ESPE) for 5 seconds and 20 seconds, DemiPlus (Kerr) standard mode for 5 seconds, SmartLite Max (Dentsply) boost mode for 5 seconds and continuous mode for 20 seconds, RadiiPlus (SDI) for 30 seconds, Valo (Ultradent) Mains in standard mode for 20 seconds and plasma mode for 3s, Valo Cordless in standard mode for 20 seconds and plasma mode for 3 seconds. The two MARC-trained operators made thirty readings with each light over seven days. The energy (J/cm²) delivered to the anterior Class III and Posterior Class I simulated restorations in MARC was recorded using a laboratory grade spectroradiometer and the time each light would take to deliver 16J/cm² calculated. ANOVA and Fisher’s PLSD tests compared differences in the time to deliver 16J/cm² of energy, α = 0.05.

Results: Three-way ANOVA showed there was no significant difference between the operators, but there was a difference between the lights and locations. The Valo Mains and Valo Cordless in the plasma mode delivered 16J/cm² in the shortest time at both locations. The Radii Plus took the longest to deliver 16J/cm², taking twice as long in the posterior location.

<table>
<thead>
<tr>
<th>Curing Light, Mode and Time</th>
<th>Mean Time (seconds) to Deliver 16J/cm²</th>
<th>SD (seconds)</th>
<th>Mean Time (seconds) to Deliver 16J/cm²</th>
<th>SD (seconds)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anterior: 1mm Deep Class III</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>VALO C, plasma 3 seconds</td>
<td>5⁴</td>
<td>0.3</td>
<td>6⁴</td>
<td>0.3</td>
</tr>
<tr>
<td>VALO M, plasma 3 seconds</td>
<td>6⁵</td>
<td>0.3</td>
<td>6⁴</td>
<td>0.5</td>
</tr>
<tr>
<td>Sapphire, std. 5 seconds</td>
<td>9⁶</td>
<td>0.2</td>
<td>9</td>
<td>0.7</td>
</tr>
<tr>
<td>Demi Plus, std. 5 seconds</td>
<td>9⁷</td>
<td>0.6</td>
<td>12⁸</td>
<td>1.0</td>
</tr>
<tr>
<td>Elipar S10, std.20 seconds</td>
<td>10⁹</td>
<td>1.2</td>
<td>11⁸</td>
<td>0.6</td>
</tr>
<tr>
<td>Elipar S10, std. 5 seconds</td>
<td>10⁹</td>
<td>1.3</td>
<td>12⁸</td>
<td>1.3</td>
</tr>
<tr>
<td>SmartLiteMax, boost 5 seconds</td>
<td>11⁰</td>
<td>1.5</td>
<td>19</td>
<td>3.1</td>
</tr>
<tr>
<td>Optilux 501, std. 20 seconds</td>
<td>12⁰</td>
<td>1.1</td>
<td>15</td>
<td>1.6</td>
</tr>
<tr>
<td>VALO C, std. 20 seconds</td>
<td>12⁰</td>
<td>0.8</td>
<td>13ⁱ</td>
<td>0.7</td>
</tr>
<tr>
<td>VALO M, std. 20 seconds</td>
<td>14⁴</td>
<td>0.8</td>
<td>13ⁱ</td>
<td>0.5</td>
</tr>
<tr>
<td>SmartLite Max, cont. 20 seconds</td>
<td>14⁴</td>
<td>1.9</td>
<td>25</td>
<td>5.6</td>
</tr>
<tr>
<td>Radii Plus, std. 30 seconds</td>
<td>14⁴</td>
<td>2.4</td>
<td>28</td>
<td>2.4</td>
</tr>
</tbody>
</table>

Values in each column not significantly different indicated by superscript letter: Fisher’s PLSD α = 0.05.

Conclusions: Depending on the location of the restoration, some curing lights can take twice as long to deliver the same amount of energy. Manufacturers of some LCUs could help clinicians to deliver the energy required to cure the selected resin by adjusting the curing times depending on the location and distance to the resin. Dalhousie and Tufts Universities supported this research.
Elipar™ S10 LED Curing Light (cont.)

3M ESPE Summary

**Aim of Study:** Determine the time needed for Elipar S10 LED Curing Light and other commercially available light curing devices to deliver 16J/cm² to an anterior or a posterior restoration.

**Summary of Results:** Elipar S10 LED Curing Light needed on average 10 seconds to deliver 16J/cm² to an anterior and 11–12 seconds for a posterior restoration.
Paradigm™ LED Curing Light

Prediction of Clinical Performance for Polymerization Devices with Different Optics-Design

J. GRAMANN, K. SCHEPKE-GERLACH, R. ZERGUINE and A. SYREK, 3M ESPE AG, Seefeld, Germany

Objectives: The aim of this study was to predict the clinically relevant curing performance of polymerization devices having different optical concepts. In particular those concepts were:

1) Monochrome LED, reflector and glassfiber light guide with uniform diameter (3M ESPE, Paradigm Curing Light).
2) Monochrome LED, reflector and tapered glassfiber light guide (Kerr, DemiPlus).
3) Two differently colored LEDs (Polywave) and Fresnel lens without light guide (Dentsply, Smartlite Max).

All devices are on a comparable power/intensity level.

Methods: Intensity of mentioned devices was measured with an Ocean Optics S2000 spectrometer and a 14mm optical sphere with 4mm aperture (according to ISO-4049 depth of cure (DOC) measurement setup). Intensity was measured at 0mm and 7mm distance between the tested device and the aperture.

In addition samples of Filtek™ Supreme Ultra Universal Restorative (3M ESPE; shade A3B) were cured with the devices for 10 seconds at 0mm and 7mm distance to measure DOC according to ISO-4049 (n = 3; cylindrical sample with 4mm in diameter). The calculated DOC attenuation values were statistically analyzed by one-way ANOVA (p < 0.05).

Results: The following values of intensity and DOC were found:

<table>
<thead>
<tr>
<th>Device</th>
<th>Intensity (mW/cm²)</th>
<th>DOC (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0mm</td>
<td>7mm</td>
</tr>
<tr>
<td>Paradigm™</td>
<td>2101 ± 105</td>
<td>931 ± 47</td>
</tr>
<tr>
<td>DemiPlus</td>
<td>2069 ± 103</td>
<td>875 ± 44</td>
</tr>
<tr>
<td>Smartlite Max</td>
<td>1870 ± 94</td>
<td>525 ± 26</td>
</tr>
</tbody>
</table>

With respect to the spectrometer’s resolution of 5%, Smartlight Max showed a higher attenuation in terms of intensity than Paradigm LED Curing Light and DemiPlus.

Regarding DOC, Paradigm showed the significantly lowest attenuation whereas Smartlite Max showed the highest one.

Conclusions: Amongst the analyzed polymerization devices 3M ESPE Paradigm LED Curing Light showed the best curing performance at 0mm distance as well as at clinically relevant distance of 7mm between the device and the filling material. Also its intensity- and DOC-attenuation values are the best among the devices tested in this study.

3M ESPE Summary

Aim of Study: To show the influence of the different optical concepts (monochrome LED and polywave) on DOC and intensity of polymerization devices.

Summary of Results: In this study Paradigm LED Curing Light showed the best curing performance at 0mm and 7mm together with the lower attenuation values.
Elipar™ S10 LED Curing Light

Effect of Curing Light on the Polymerization of Resin Cement

M.Q. ALQAHTANI¹, M.M. ALSHAAFI¹, R.B. PRICE² and C.M. FELIX², ¹Restorative Dental Sciences, King Saud University, Riyadh, Saudi Arabia, ²Dental Clinical Sciences, Dalhousie University, Halifax, NS, Canada

Objectives: Adequate polymerization of resin cement under ceramic restorations is an important factor to obtain adequate physical and biological properties. This study examined the effect of selecting single-peak vs. polywave emission LED curing light on the Degree of Conversion (DC) and Knoop-microhardness (KHN) of resin cement when they were light cured through a ceramic disc.

Methods: Two shades (A1 and A4) of resin cement (Variolink-II, Ivoclar-Vivadent) were used in a 0.5mm thick ring. The top surfaces were covered with a Mylar strip and further covered with a disc of 1mm thick shade A2 Empress Esthetic ceramic. The specimens were light cured using an Elipar S10 LED Curing Light (3M ESPE, single-peak LED) delivering 13.6J/cm², or the BluePhase-G2 (Ivoclar-Vivadent, polywave-LED) delivering 9.8J/cm² of energy. Both lights were used for 20 seconds to cure the resin specimens directly on the surface of a Golden Gate Attenuated Total Reflectance FT-IR plate that was heated to 30°C. The DC of the resin was calculated after 100 seconds. The specimens were removed and the KHN was immediately tested and again after 24 hours storage in the dark at 37°C and 100% humidity. Five specimens were made and tested in each group. The DC and KHN results were analyzed with ANOVA and Fischer’s PLSD at $\alpha = 0.05$.

Results: The choice of curing light had no significant effect on the DC and only a small effect on the immediate and 24 hours KHN values. Shade A4 was harder and better DC than A1.

<table>
<thead>
<tr>
<th>Shade</th>
<th>Light Type</th>
<th>DC Mean (SD)</th>
<th>Immediate KHN Mean (SD)</th>
<th>24-hrs KHN Mean (SD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A1</td>
<td>Polywave</td>
<td>0.594 (0.008)$^a$</td>
<td>2.98 (0.23)</td>
<td>8.10 (0.43)$^a$</td>
</tr>
<tr>
<td></td>
<td>Single</td>
<td>0.605 (0.008)$^a$</td>
<td>2.71 (0.30)</td>
<td>8.30 (0.43)$^a$</td>
</tr>
<tr>
<td>A4</td>
<td>Polywave</td>
<td>0.611 (0.011)$^b$</td>
<td>3.37 (0.17)$^c$</td>
<td>9.09 (0.52)</td>
</tr>
<tr>
<td></td>
<td>Single</td>
<td>0.619 (0.006)$^b$</td>
<td>3.45 (0.20)$^c$</td>
<td>8.77 (0.44)</td>
</tr>
</tbody>
</table>

Superscript letters = Homogeneous subsets-(Fischer’s $\alpha=0.05$).

Conclusions: The small differences in the DC and KHN values achieved using the Single-Peak and Polywave curing lights are probably not clinically significant and either light could be used. Shade A4 was slightly harder than A1.

This abstract is based on research that was funded entirely or partially by an outside source: This Study was supported by Research Group Fund # RGP- VPP-146, Deanship of Scientific Research, King Saud University and Dalhousie University.

3M ESPE Summary

Aim of Study: To compare the effect of selecting single-peak (Elipar S10 LED Curing Light) vs. polywave emission LED curing light on the degree of conversion and Knoop-microhardness of resin cement when they were light cured through a ceramic disc.

Summary of Results: The choice of curing light had no significant effect on the DC and only a small effect on the immediate and 24 hours KHN values. The small differences in the DC and KHN values achieved using the Single-Peak and Polywave curing lights are probably not clinically significant and either light could be used.
Performance of Stand-Alone Dental Radiometers for Light Output Check

R. ZERGUINE, J. GRAMANN, S. HERTLEIN, D.D. KRUEGER, 3M ESPE, Seefeld, Germany

Objectives: Optimal polymerization of dental materials depends on several factors among which light output of the curing unit. Aim of this study is to compare the irradiance of six curing lights (Paradigm LED Curing Light, 3M ESPE; DemiPlus, Kerr; SmartLite® Max, Dentsply; bluephase®, Ivoclar Vivadent; VALO cordless, Ultradent; Radii Plus, SDI) measured with 3 commercial dental radiometers (LED Radiometer, Kerr; LED Radiometer, SDI; bluephase meter, Ivoclar Vivadent) with the irradiance declared by the manufacturer.

Methods: The light output of mentioned devices was measured five times (n = 5) with each of the three radiometers. The offset between the recorded mean values and the irradiance values stated by the light manufacturers was calculated (given in %). Data collected was statistically analyzed using one-way ANOVA (p ≤ 0.05).

Results: The following irradiance values were measured:

<table>
<thead>
<tr>
<th>Device</th>
<th>Claimed Irradiance* (mW/cm²)</th>
<th>LED Radiometer (Kerr)</th>
<th>LED Radiometer (SDI)</th>
<th>bluephase Meter (Ivoclar Vivadent)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Paradigm</td>
<td>1200</td>
<td>700 ± 0.00</td>
<td>-41.67 ± 0.00</td>
<td>1379 ± 17.10</td>
</tr>
<tr>
<td>DemiPlus</td>
<td>1100</td>
<td>700 ± 27.39</td>
<td>-33.64 ± 2.49</td>
<td>1642 ± 91.83</td>
</tr>
<tr>
<td>SmartLite max</td>
<td>1200</td>
<td>320 ± 27.39</td>
<td>-73.33 ± 2.28</td>
<td>434 ± 24.85</td>
</tr>
<tr>
<td>Bluephase</td>
<td>1200</td>
<td>700 ± 0.00</td>
<td>-41.67 ± 0.00</td>
<td>1001 ± 17.10</td>
</tr>
<tr>
<td>VALO cordless</td>
<td>1400</td>
<td>570 ± 27.39</td>
<td>-59.29 ± 1.96</td>
<td>1099 ± 48.40</td>
</tr>
<tr>
<td>Radii Plus</td>
<td>1500</td>
<td>530 ± 27.39</td>
<td>-64.67 ± 1.83</td>
<td>1920 ± 0.00</td>
</tr>
</tbody>
</table>

There was important variability of irradiance measurements between different radiometers. Kerr radiometer showed significantly lower irradiance values than the values registered by the other radiometers and those stated by the manufacturers. Radii Plus and DemiPlus were the devices with the highest variability. Differences between claimed and measured irradiance were significant for all tested devices, except for Paradigm when tested with the bluephase meter.

Conclusions: All curing lights tested showed high variability in irradiance readings. There was no positive intra-brand correlation curing light-radiometer. For curing light performance, check stand-alone radiometers are not reliable, therefore other testing methods should be considered (e.g. resin curing tests).

3M ESPE Summary

Aim of Study: To compare the claimed irradiance of Paradigm LED Curing Light and five other commercial curing lights to the irradiance measured with commercial radiometers.

Summary of Results: There were significant differences between the claimed irradiance and the irradiance values measured with the radiometers, except for Paradigm when measured with bluephase radiometer.
AADR

AADR 2012  Abstract #441
Shear Bond Strength of Three Resin-Modified-Glass-Ionomers Following Six Surface Treatments
R.W. AMOS¹, T.A. IMBERY², A. DUNCAN², A. NAMBOODIRI², A.M. BEST¹ and P.C. MOON¹, ¹General Practice, Virginia Commonwealth University — VCU/MCV, Richmond, VA, ²VCU, Richmond, VA, ³Virginia Commonwealth University — VCU/MCV, Richmond, VA

AADR 2012  Abstract #477
Translucency of Resin Modified Glass Ionomer Restoratives
C. DECOTEAU, M. OGLEDZKI, R.D. PERRY and G. KUGEL, Tufts University, Boston, MA

AADR 2012  Abstract #635
μTBS of New Resin-Modified Glass-Ionomer Cements: Effect of Dentin Pretreatment
Y.F. ALFAWAZ, Operative Dentistry, King Saud University Dental School, Riyadh, Saudi Arabia, N.B. COOK, Restorative Dentistry, University of Indiana — Indianapolis, Indianapolis, IN and M.C. BOTTINO, School of Dentistry, Indiana University, Indianapolis, IN

AADR 2012  Abstract #845
Effect of Protective Coating on Fluoride Release from Glass Ionomer
D.S. YANG and E.C. WANG, School of Dentistry, Loma Linda University, Loma Linda, CA

AADR 2012  Abstract #1048
Influence of a Nanofilled Coating on Physical Properties of Glass Ionomer Cements
U. LOHBAUER and A. PETSCHELT, Dept. of Operative Dentistry & Period, University of Erlangen, Erlangen, Germany

IADR

IADR 2012  Abstract #116
Effect of Setting-Condition and pH on Fluoride-Release of Dental Materials
C. SHEN, M. BARRY and K. SÖDERHOLM, Restorative Dental Sciences, University of Florida, Gainesville, FL

IADR 2012  Abstract #1149
Mineral Content Evaluation of Carious Dentin Treated by Minimal Intervention
A.C. CHIBINSKI and D.S. WAMBIER, Universidade Estadual De Ponta Grossa, Ponta Grossa, Paraná, Brazil

IADR 2012  Abstract #1330
Microshear Bond Strength of Flowable GIC to Caries-Affected Dentin
T.K. TEDESCO¹, C.C. BONIFÁCIO², D. HESSE², C.J. KLEVERLAAN², T.L. LENZI¹ and D.P. RAGGIO¹, ¹Pediatric Dentistry, University of São Paulo, São Paulo, Brazil, ²ACTA, Amsterdam, Netherlands, ³Dental Materials Science, Academic Centre for Dentistry Amsterdam, Amsterdam, Netherlands
**Abstract #1737**

**Compressive Strength of Resin-Modified Glass-Ionomer Cements with Bioactive Glass-ceramics Nanoparticles**

M.C. FREITAS, University of Sao Paulo, Bauru-SP, Brazil, T. FAGUNDES, University of São Paulo, Birigui, São Paulo, Brazil, L. WANG, Operative Dentistry, Bauru School of Dentistry — University of Sao Paulo, Bauru, SP, Brazil and M. ATTA, Faculdade de Odontologia de Bauru, Universidade de São Paulo, Bauru, Brazil

**Abstract #2023**

**In Situ Anticariogenic Effect of Fluoridated Materials on Human Dentin**

G.A. KIRSTEN¹, M.K. TAKAHASHI¹, R.N. RACHED¹, R.F. MAZUR¹, M. GIANNINI² and E.M. SOUZA¹, ¹Graduation Program in Dentistry, Pontifical Catholic University of Paraná, Curitiba, Brazil, ²Restorative Dentistry, State University of Campinas, Piracicaba, SP, Brazil
Impregum™ Penta™ Impression Material

An Approach to Determine the Scannability of Dental Impression Materials

J.C. FARR, T. KLETTKE, J. ZECH and A. THALER, 3M ESPE, Seefeld, Germany

Objectives: Aim of this study was to develop a method for measuring the scannability of impression materials in commercial red-light impression scanners. STL (surface tessellation language) files created by the scanners define the surface of 3D objects as triangles. Here we present a first approach and initial measurements to describe the scannability of impression materials as the ratio of number of triangles and surface.

Methods: Impressions of the same model dye (Frasaco) made with four materials — polyether (ImP, Impregum™ Penta™ Impression Material, 3M ESPE, #441251–Base, #417456–Catalyst), vinyl polyether silicone material optimized for scannability (IdS, Identium Scan Heavy, #110141–05/Identium Scan Light, #110021, Kettenbach) and two vinylpolysiloxane materials (AqX, Aquasil UltraXLV, Dentsply; #100803, T1A, Take1 Advanced LightBody FastSet, Kerr, #0-1124) — were scanned in a red-light impression scanner (iSeries, Dentalwings, n = 5). STL files were analyzed with 3D software (3D-Tool-FreeViewer).

Results: The ratio of the number of triangles in the STL file and the surface of the impression scan was calculated (table). All data were analyzed by 1-way-ANOVA with general linear model and pairwise comparison using Tukey test (p < 0.05). All materials were found to be significantly different from each other.

Conclusions: Within the limitation of this study it can be concluded that a low Triangle/Surface-Ratio indicates good scannability. More triangles in relation to a constant surface will be generated when a material is harder to scan. The Surface/Triangle-Ratio was lowest for the scannable material IdS, followed by ImP. Standard VPS impression materials showed less scannability. Further investigations are needed to better understand the scannability of dental impression materials especially in a clinical setting.

<table>
<thead>
<tr>
<th>Material</th>
<th>Triangle/Surface-Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>ImP</td>
<td>52.3 (1.23)b</td>
</tr>
<tr>
<td>IdS</td>
<td>47.6 (0.32)a</td>
</tr>
<tr>
<td>AqX</td>
<td>61.9 (0.40)c</td>
</tr>
<tr>
<td>T1A</td>
<td>74.6 (1.71)d</td>
</tr>
</tbody>
</table>

3M ESPE Summary

Aim of Study: To develop a method for measuring the scannability of impression materials in commercial red-light impression scanners.

Summary of Results: A low Triangle/Surface-Ratio indicates good scannability. The Surface/Triangle-Ratio was lowest for the scannable material Identium Scan, followed by Impregum Penta Impression Material.
Imprint™ 3 Quick Step Light Body Impression Material

Shore Hardness of VPS Materials From Unset to Set Consistency

M. NEGLIA, D. NOBREGA, G. KUGEL and R.D. PERRY, Tufts University, Boston, MA

Objectives: To evaluate the transition from the unset to the set stage of seven VPS wash materials. Shore A Hardness was recorded from the unset to the set stage.

Methods: Six marketed VPS wash products were tested: Aquasil UltraLV Fast Set (AQU, DENTSPLY, LOT# 100608), EXA’lence Light Body Regular Set (ELB, GC America Inc., LOT# 1012131), Flexitime Light Flow (FLF, Heraeus, LOT# 350024), Imprint™ 3 Quick Step Light Body Impression Material (IQS, 3M ESPE, LOT# 439507), Panasil Initial Contact Light (PCL, Kettenbach, LOT# 110251), Take 1 Advantage Light Body Wash (TAL, Kerr, LOT# 34149). One experimental VPS light body was tested, Experimental Wash (EXP, 3M ESPE, Lab-FW-Misch-0574). Samples were collected (n = 6) and measurements were recorded by Durometer (Zwick) according to ASTM D2240, from the earliest available measurement to a final consistent setting time at 15 second intervals at room temperature (23°C). A one-way ANOVA and a Tukey test were conducted to determine the statistical significance (Minitab version 15).

Results: Final hardness was calculated and used as the baseline for what 100% hardness would be considered and each value was compared according to that value. Each of the individual materials showed a linear behavior between 0 and 80% of the final hardness. This area was used to determine the slope at which setting occurred. EXP was found to have the significantly steepest slope (p < 0.05).

Conclusions: Of all materials tested, EXP showed the steepest slope during setting indicating that this material may facilitate a shorter setting time of all the materials tested.

Results found in abstracts for Imprint™ 3 Quick Step Light Body Impression Material also apply to Express™ 2 Ultra Light Body Quick Impression Material.

Results found in abstracts for Imprint™ 3 Quick Step Light Body Impression Material also apply to Express™ 2 Ultra Light Body Quick Impression Material.
Comparing of VPS Materials in the Unset Stage

M. NEGLIA, D. NOBREGA, N. SHAKOURIAN, G. KUGEL and R.D. PERRY, Tufts University, Boston, MA

Objectives: To evaluate the initial water contact angles of seven VPS wash materials in the unset stage using a standardized method in an effort to determine which material(s) would produce the most accurate impression.

Methods: The hydrophilic properties of VPS wash materials were determined by the commercially available Drop Shape Analysis System DSA 30 (Kruss). Materials tested included six marketed VPS light body products: Aquasil UltraLV Fast Set (AQU, DENTSPLY, LOT# 100608), EXA’lence Light Body Regular Set (ELB, GC America Inc., LOT# 1012131), Flexitime Light Flow (FLF, Heraeus, LOT# 350024), Imprint™ 3 Quick Step Light Body Impression Material (IQS, 3M ESPE, LOT# 439507), Panasil Initial Contact Light (PCL, Kettenbach, LOT# 110251), Take 1 Advantage Light Body Wash (TAL, Kerr, LOT# 34149). In addition one experimental VPS light body was tested, Experimental Wash (EXP, 3M ESPE, Lab-FW-Misch-0574). Samples were collected (n = 6) for each material at room temperature (23°C) and measurements were recorded at 25 frames/second. Contact angles 20 seconds after start of mix at 2 seconds drop age were used as a basis for comparison. A one-way ANOVA and a Tukey test were conducted to determine the statistical significance (Minitab version 15).

Results:

<table>
<thead>
<tr>
<th>Contact Angle Values at 2 seconds</th>
</tr>
</thead>
<tbody>
<tr>
<td>Materials (n=6)</td>
</tr>
<tr>
<td>-----------------</td>
</tr>
<tr>
<td>AQU</td>
</tr>
<tr>
<td>ELB</td>
</tr>
<tr>
<td>EXP</td>
</tr>
<tr>
<td>FLF</td>
</tr>
<tr>
<td>IQS</td>
</tr>
<tr>
<td>PCL</td>
</tr>
<tr>
<td>TAL</td>
</tr>
</tbody>
</table>

Materials with the same letters are not significantly different from each other.

Conclusions: All materials showed contact angles small enough to be considered hydrophilic (θ < 90). Experimental Wash was found to have the lowest mean contact angle (23.183°, p < 0.05), indicating that when taking an impression this material may have the most rapid hydrophilic effect, possibly producing an impression with more detail. The clinical relevance has yet to be tested.
Pentamix™ 3 Automatic Mixing Unit, Express™ XT VPS Impression Material, Impregum™ Impression Material

Attitude of Graduate Students on Mixing Techniques for Impression Materials

G. RIBEIRO¹, L. VASCONCELOS¹, L. MIRAGAYA², S.M. MORGANO³ and C.E. SABROSA¹, ¹Universidade do Estado do Rio de Janeiro, Rio de Janeiro, Brazil, ²UFF, Rio de Janeiro, Brazil, ³Boston University, Boston, MA

Introduction: Electronic and auto-mixing methods have been reported to provide superior overall results when compared with hand-mixing technique.

Objectives: This study was to compare 30 graduate students in prosthodontics and operative dentistry with regard to mixing impression materials. Variables investigated included the quality, quantity and duration of mixing, amount of wasted material and preferences of the professors.

Methods: Evaluation was divided into 3 groups. The first group compared medium-body polyether impression material (Impregum™ Soft Impression Material, 3M ESPE) mixed by hand and with an electronic mixer (Pentamix™ 3 Automatic Mixing Unit). The second group compared putty-viscosity c-silicone impression material (Speedex, Coltene) mixed by hand and a vinyl poly siloxane impression material (VPS) (Express™ XT Penta™ Putty Impression Material, 3M ESPE) with an electronic mixer (Pentamix 3 Automatic Mixing Unit). The third group compared light-body VPS (Express XT Impression Material, 3M ESPE) mixed with the auto-mix system (Garant™ Dispenser) and a light-body condensation-silicone material (Speedex, Coltene) mixed by hand. The mixing process for each participant was timed and the amount of wasted material was measured. Participants completed a survey at the conclusion of the mixing exercises regarding preferences. Mean values were compared within participant groups with paired t test (a = 0.05).

Results: Overall preference of the electronic and auto-mixing techniques were statistically significantly higher than hand-mixing technique (p < 0.05). There was a great variability on the amount of material dispensed. There was a statistically significantly higher amount of material wasted when the hand-mix technique was used (p < 0.05). For all three comparisons there was a statistical significantly longer period of time used to manipulate materials manually compared with the electronic and automix techniques.

Conclusions: Under the limitations of this study it can be concluded that the electronic and the automix techniques are preferred methods for mixing impression materials. Furthermore the electronic and automix techniques seem to minimize the waste of material in addition to providing a faster mixing.

3M ESPE Summary

Aim of Study: To evaluate the attitude of graduate students on mixing techniques for impression materials different mixing techniques were compared for different impression materials. For electronic mixing, Pentamix 3 Automatic Mixing Unit was used.

Summary of Results: Electronic and automixing techniques were found to be preferred over hand-mixing techniques for all materials.

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http://iadr.confex.com/iadr/2012tampa/webprogram/
Attitude of Professors on Mixing Techniques for Impression Materials

L. VASCONCELOS1, B. SARTORI1, S.M. MORGANO2 and C.E. SABROSA1, 1Universidade do Estado do Rio de Janeiro, Rio de Janeiro, Brazil, 2Boston University, Boston, MA

Introductions: Preferences in techniques for mixing impression materials vary among dentists. The use of electronic and auto-mix systems is the trend because of their ease of use.

Objectives: The objective of this study was to compare 30 professors in prosthodontics, operative dentistry and biomaterials with regard to mixing impression materials. Variables investigated included the quality, quantity and duration of mixing, amount of wasted material and preferences of professors.

Methods: Evaluation was divided into 3 groups. The first group compared medium-body polyether impression material (Impregum™ Soft Impression Material, 3M ESPE) mixed by hand and with an electronic mixer (Pentamix™ 3 Automatic Mixing Unit). The second group compared putty-viscosity c-silicone impression material (Speedex, Coltene) mixed by hand and a vinyl poly siloxane impression material (VPS) (Express™ XT Penta™ Putty Impression Material, 3M ESPE) with an electronic mixer (Pentamix 3 Automatic Mixing Unit). The third group compared light-body VPS (Express XT Impression Material, 3M ESPE) mixed with the auto-mix system (Garant™ Dispenser) and a light-body condensation-silicone material (Speedex, Coltene) mixed by hand. The mixing process for each participant was timed and the amount of wasted material was measured. Participants completed a survey at the conclusion of the mixing exercises regarding preferences. Mean values were compared within participant groups with paired t test (a = 0.05).

Results: Overall preference for the electronic and auto-mixing techniques was statistically significantly higher when compared with hand-mixing (p = 0.001). The duration of mixing was statistically significantly lower when electronic mixing was used over hand-mixing (p = 0.001). There was no statistically significant difference in the amount of material used when comparing the electronic and the hand-mixing technique (p = 0.001). There was a large variability in wasted material with hand-mixing.

Conclusions: Under the limitations of this study, it was concluded that the electronic and the auto-mix techniques were preferred by most professors. Furthermore, the electronic and auto-mix techniques provided faster mixing with less variation in waste.

3M ESPE Summary

Aim of Study: The attitude of professors towards different impression material mixing techniques was evaluated. For electronic mixing, Pentamix 3 Automatic Mixing Unit was used.

Summary of Results: Electronic and automixing techniques were found to be preferred over hand-mixing techniques for all materials by university professors.

Preference of graduate students for mixing techniques.
3M™ ESPE™ Retraction Capsule

Preliminary Report on Changes After Soft-Tissue Management: 1-Year Results

Thursday, March 22, 2012: 10:45 a.m. – 12:15 p.m.
Location: Room 18 (Tampa Convention Center)
Presentation Type: Oral Session
T.A. MARTIN, H. RUDOLPH, M. HRUSA, B.A. JUST and R.G. LUTHARDT, Department für Zahnheilkunde Klinik für Zahnärztliche Prothetik, Ulm University, Ulm, Germany

Objectives: In dental impressions, the complete and correct reproduction of the preparation margin is most important. Various procedures and medicaments can be used for soft-tissue management. In a clinical trial, the gingival recession after using two different procedures was assessed by a three-dimensional analysis of the resulting gypsum models.

Methods: The study design implies a cross-over after 6 months (change of quadrant, artificial gingivitis) at a total duration of 12.5 months. Saw-cut models of 20 probands were made after applying either the double-chord-technique (roeko Retracto, impregnated, size 1&2, Coltène/Whaledent, Germany) or an aluminum-chloride containing paste (Expasyl, PierreRolland, France) for soft-tissue management on the palatal aspect of the upper premolars. Teeth in the contralateral quadrant served as control. Impressions were made before each intervention (reference), after three and six months (follow-up). Probands received professional tooth cleaning before baseline impression, before refraining from tooth brushing for artificial gingivitis and immediately after the second intervention. After digitizing (digiSCAN, AmannGirrbach, Germany), follow-up data was aligned to baseline data for analysis (geomagic studio and qualify 9.0, geomagic Inc., USA). Statistical analysis was performed with SPSS Statistics 17.0 (SPSS Inc., USA).

Results:

<table>
<thead>
<tr>
<th>Variable</th>
<th>Measurement Location</th>
<th>Mean</th>
<th>Standard Error</th>
<th>95% — Confidence Interval</th>
<th>Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Intervention</td>
<td>Mesial papilla</td>
<td>0.009</td>
<td>0.036</td>
<td>-0.063 – 0.080</td>
<td>0.586</td>
</tr>
<tr>
<td></td>
<td>Distal papilla</td>
<td>0.013</td>
<td>0.036</td>
<td>-0.058 – 0.084</td>
<td>0.394</td>
</tr>
<tr>
<td></td>
<td>Mid-marginal gingiva</td>
<td>0.014</td>
<td>0.029</td>
<td>-0.044 – 0.071</td>
<td>0.237</td>
</tr>
<tr>
<td>No intervention</td>
<td>Mesial papilla</td>
<td>0.037</td>
<td>0.037</td>
<td>-0.035 – 0.109</td>
<td>0.586</td>
</tr>
<tr>
<td></td>
<td>Distal papilla</td>
<td>-0.031</td>
<td>0.036</td>
<td>-0.102 – 0.040</td>
<td>0.394</td>
</tr>
<tr>
<td></td>
<td>Mid-marginal gingiva</td>
<td>-0.035</td>
<td>0.029</td>
<td>-0.093 – 0.022</td>
<td>0.237</td>
</tr>
<tr>
<td>Follow-up, 3-months</td>
<td>Mesial papilla</td>
<td>0.061</td>
<td>0.032</td>
<td>-0.003 – 0.125</td>
<td>0.095</td>
</tr>
<tr>
<td></td>
<td>Distal papilla</td>
<td>0.010</td>
<td>0.031</td>
<td>-0.052 – 0.071</td>
<td>0.360</td>
</tr>
<tr>
<td></td>
<td>Mid-marginal gingiva</td>
<td>-0.024</td>
<td>0.013</td>
<td>-0.050 – 0.002</td>
<td>0.728</td>
</tr>
<tr>
<td>Follow-up, 6-months</td>
<td>Mesial papilla</td>
<td>-0.024</td>
<td>0.039</td>
<td>-0.202 – 0.053</td>
<td>0.095</td>
</tr>
<tr>
<td></td>
<td>Distal papilla</td>
<td>-0.037</td>
<td>0.040</td>
<td>-0.115 – 0.042</td>
<td>0.360</td>
</tr>
<tr>
<td></td>
<td>Mid-marginal gingiva</td>
<td>-0.010</td>
<td>0.038</td>
<td>-0.085 – 0.066</td>
<td>0.728</td>
</tr>
</tbody>
</table>

Conclusions: Careful use of two different procedures for soft-tissue management did not cause permanent gingival recession. A mild artificial gingivitis did not have a negative influence.

Sponsoring: 3M ESPE

This abstract is based on research that was funded entirely or partially by an outside source: 3M ESPE, Seefeld, Germany

continued on next page >
3M™ ESPE™ Retraction Capsule

3M ESPE Summary

**Aim of Study:** In a clinical trial, the gingival recession after using two different procedures was assessed by a three-dimensional analysis of the gypsum models resulting from impressions with Impregum™ Impression Materials. Double-chord-technique (roeko Retracto, impregnated, size 1 and 2, Coltène/Whaledent, Germany) and an aluminum-chloride containing paste (Expasyl, PierreRolland, France) were used for soft-tissue management on the palatal aspect of the upper premolars.

**Summary of Results:** Careful use of the two different procedures for soft-tissue management did not cause permanent gingival recession.
Reliability of Soft-Tissue Measurement Applying a Three-Dimensional Computer-Aided Analysis

Friday, March 23, 2012: 8:00 a.m. – 9:30 a.m.
Location: Room 18 (Tampa Convention Center)
Presentation Type: Oral Session
H. RUDOLPH, M. HRUSA, T. MARTIN, B.A. JUST and R.G. LUTHARDT, Department of Prosthetic Dentistry, Ulm University, Ulm, Germany

Objectives: The growing emphasis on red-white aesthetics in prosthetic dentistry has created a demand for an objective assessment. The reliability of the three-dimensional computer-aided analysis developed for this purpose concerning soft-tissue measurements had to be verified.

Methods: Saw-cut models of 20 probands were made from impressions taken after soft-tissue management on the palatal side of 24 and 25 or 14 and 15. The teeth in the contralateral quadrant served as control. After digitizing (digiSCAN, AmannGirrbach, Germany) baseline and follow-up models, data was orientated according to a constructed occlusal plane. Hard- and soft-tissue reference points were constructed (cuspit, mesial and distal marginal ridge, mesial and distal interdental papilla tip, mid-marginal gingiva) and the distance between corresponding reference points was calculated (geomagic studio and qualify 9.0, geomagic Inc., USA). As the distal interdental papilla of the first premolar is identical with the mesial interdental papilla of the second premolar, these values could be used for verifying the measurements’ reliability. Statistical analysis was performed with SPSS Statistics 17.0 (SPSS Inc., USA) at = 0.05.

Results: No significant difference was found between the measurements of the interdental papilla between first and second premolar (p = 0.839). The mean value for 14/24 was 0.0164 (SE: 0.0287, 95% CI: 0.0731-0.0404) and 0.0074 (SE: 0.0333, 95% CI: 0.0733-0.0585) for 15/25.

Conclusions: The developed method showed to be reliable for the assessment of the soft-tissue contour. Once constructed, the same hard-tissue reference points can be used for the calculation of differences to soft-tissue reference points recorded by impressions at any given time. The orientation according to the occlusal plane minimizes errors in the calculation of differences. Measurements can show changes in soft-tissue over time in a clinically relevant range.

This abstract is based on research that was funded entirely or partially by an outside source: 3M ESPE, Seefeld, Germany

3M™ ESPE™ Retraction Capsule

Reliability of Soft-Tissue Measurement Applying a Three-Dimensional Computer-Aided Analysis

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This abstract is based on research that was funded entirely or partially by an outside source: 3M ESPE, Seefeld, Germany

3M ESPE Summary

Aim of Study: To verify the reliability of a newly developed three-dimensional computer-aided analysis for an objective assessment concerning soft-tissue measurements related to temporary gingival retraction.

Summary of Results: The developed method showed to be reliable for the assessment of the soft-tissue contour. Measurements can show changes in soft-tissue over time in a clinically relevant range.
3M™ ESPE™ Retraction Capsule

Penetration Depths and Volumes of Different Retraction Pastes

Friday, March 23, 2012: 3:30 p.m. – 4:45 p.m.
Presentation Type: Poster Session
D. NOBREGA, M. NEGLIA, G. KUGEL and R.D. PERRY, Tufts University, Boston, MA

Objectives: To measure the depth of gingival penetration and volume of material for four retraction pastes and the depth of penetration for two different-sized retraction cords.

Methods: In a polystyrene mold (30mm X 30mm X 12mm), Post-it® Index Notes (3M) were used as place-holders to create a simulated gingival sulcus 8mm-deep with widths of 0.06mm, 0.13mm and 0.19mm. The mold was filled with Permadyne™ Impression Material (3M ESPE) hand-mix polyether impression material to simulate the gingiva. After setting, the elastomeric block was removed from the mold, the upper-edge cut at 45°, replaced in the mold and mass measured. Four retraction pastes 3M™ ESPE™ Retraction Capsule (RC, 3M ESPE), Expasyl (EX, Acteon Pharma), GingiTrac Minimix (GT, Centrix) and Traxodent (TR, Premier) were added to the sulci according to manufacturer’s instructions and weighed after each insertion. Two retraction cords Ultrapak#3 (Ultradent) and Ultrapak#000 (Ultradent) were placed as controls. Depth measurements were taken. Each material was measured 8-times at each sulcus-width. Data was analyzed using One-Way-ANOVA and Tukey’s-Test with Minitab15.

Results:

<table>
<thead>
<tr>
<th>Sulcus-Width</th>
<th>Material</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>RC</td>
<td>EX</td>
<td>GT</td>
<td>TR</td>
</tr>
<tr>
<td>Depth (mm)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0.06</td>
<td>6.13 ± 0.612</td>
<td>4.75 ± 0.935</td>
<td>5.81 ± 0.961</td>
<td>3.56 ± 0.438</td>
</tr>
<tr>
<td>0.13</td>
<td>6.66 ± 0.442</td>
<td>5.38 ± 0.655</td>
<td>6.47 ± 0.700</td>
<td>4.38 ± 0.582</td>
</tr>
<tr>
<td>0.19</td>
<td>7.06 ± 0.530</td>
<td>6.16 ± 0.566</td>
<td>7.56 ± 0.438</td>
<td>4.63 ± 0.354</td>
</tr>
<tr>
<td>Volume (mm³)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0.06</td>
<td>0.0626 ± 0.0141</td>
<td>0.0472 ± 0.0125</td>
<td>0.0245 ± 0.0089</td>
<td>0.0168 ± 0.0030</td>
</tr>
<tr>
<td>0.13</td>
<td>0.0803 ± 0.0164</td>
<td>0.0596 ± 0.0191</td>
<td>0.0324 ± 0.0126</td>
<td>0.0223 ± 0.0077</td>
</tr>
<tr>
<td>0.19</td>
<td>0.0840 ± 0.0144</td>
<td>0.0767 ± 0.0219</td>
<td>0.0450 ± 0.0101</td>
<td>0.0252 ± 0.0066</td>
</tr>
</tbody>
</table>
Conclusions: At each sulcus-width, RC and GT were inserted to similar depths, while EX had a significantly shallower depth. TR showed the shallowest depth ($p < 0.05$). At sulcus-widths of 0.06mm and 0.13mm, volume of RC was significantly greater than the other pastes, while EX had greater volume than GT and TR ($p < 0.05$). At 0.19mm sulcus-width, similar volumes of RC and EX were observed, while there was significantly less volume of GT. TR had a volume lower than all other pastes ($p < 0.05$). This data may have clinical relevance in selecting an appropriate paste for gingival retraction based on desired depth and width of retraction.

This abstract is based on research that was funded entirely or partially by an outside source: 3M ESPE

3M ESPE Summary

Aim of Study: To measure the depth of gingival penetration as well as the inserted volume of material for four retraction pastes and the depth of penetration for two different-sized retraction cords. The higher the penetration depth and volume of pastes that can be applied into the sulcus the higher retraction of gingival tissue can be expected in a clinical setting.

Summary of Results: At each sulcus-width, RC and GT were inserted to similar depths, while all other products tested had a significantly shallower depth. At sulcus-widths of 0.06mm and 0.13mm, volume of RC was significantly greater than the other pastes. At 0.19mm sulcus-width volumes for RC and EX were higher than for the other materials investigated.
Objectives: Retraction pastes and gels are used to displace gingival tissues prior to making an impression. If pastes or gels are used without retraction cord, they must be able to effectively deflect the gingival tissue around the margin of the prepared tooth in order to ensure an accurate impression. The better the paste or gel resists displacement, the better the gingival retraction. However, a suitable method to evaluate this displacement does not yet exist. In this study, a new in-vitro method to measure and compare the force that is required to displace retraction pastes and gels was used.

Methods: A Zwick Z020 (Zwick Roell Comp., Germany) with a brass mold (diameter 8.0mm, depth 5.6mm) and a piston (diameter 6.0mm) from brass was used as the test equipment. The mold was completely filled with paste. Then the piston was moved into the mold (drive speed 0.25mm/second) displacing the paste. At a penetration depth of 4.0mm the force was recorded.

The investigated materials were: 3M ESPE Retraction Capsule (RC, #AWT-008, 3M ESPE), Expasyl (Ex, #3416, Acteon), Traxodent (Tr, #5834HMD, Premier), Hemostasyl (He, #3581, Acteon), Racegel (Ra, #B00852AC, Septodont), Gel Cord (GC, #L080122, Pascal), ViscoStat Clear (VC, #B5LLD, Ultradent).

Results: Mean values and corresponding standard deviations are shown (n = 6). Data was analyzed using One-way ANOVA (p < 0.05). Values with the same letters in the superscript are not significantly different.

<table>
<thead>
<tr>
<th>Material</th>
<th>Force [N]</th>
</tr>
</thead>
<tbody>
<tr>
<td>RC</td>
<td>16.7 (0.8)b</td>
</tr>
<tr>
<td>Ex</td>
<td>28.6 (1.7)a</td>
</tr>
<tr>
<td>Tr</td>
<td>3.1 (0.3)c</td>
</tr>
<tr>
<td>He</td>
<td>&lt;1d</td>
</tr>
<tr>
<td>Ra</td>
<td>&lt;1d</td>
</tr>
<tr>
<td>GC</td>
<td>&lt;1d</td>
</tr>
<tr>
<td>VC</td>
<td>&lt;1d</td>
</tr>
</tbody>
</table>

[Graph showing force required for displacement]
**3M™ ESPE™ Retraction Capsule (cont.)**

**Conclusions:** This new measurement method distinguishes between the flow resistance of various retraction pastes and gels. He, Ra, GC, VC were too flowable to show any resistance. The resistance of Tr was slight while RC and EX showed substantial flow resistance.

In a clinical setting, only materials that are highly resistant to flow should be considered when used without retraction cord. Low flow resistant materials should be used in combination with cord(s) to ensure adequate retraction.

**3M ESPE Summary**

**Aim of Study:** Aim of the study was to determine the force required to displace pastes and gels for gingival retraction. The better the paste or gel resists displacement, the better the gingival retraction.

**Summary of Results:** Only RC and EX showed substantial flow resistance. According to the method employed RC and Ex products should be more suitable for gingival retraction than the other products investigated.
Protemp™ 4/Plus Temporization Material

Bond Strength of Self-Adhesive Cement to Bis-Acrylic Composite and Acrylate-Polymer

Thursday, March 22, 2012: 2:00 p.m. – 3:15 p.m.
Location: East Hall (Tampa Convention Center)
Presentation Type: Poster Session
B. MONTEIRO¹, S. OLIVEIRA¹, S.M. MORGANO² and C.E. SABROSA¹, ¹Universidade do Estado do Rio de Janeiro, Rio de Janiero, Brazil, ²Boston University, Boston, MA

Introduction: Bis-acrylic composite resin and CAD/CAM acrylate polymer materials possess good long-term stability and can be used for long-term provisional restorations when cemented with resin cements.

Objectives: To compare the shear bond strength of self-adhesive resin cement (RelyX™ Unicem Self-Adhesive Resin Cement in the Clicker™ Dispenser, 3M ESPE) to bis-acrylic composite resin and CAD/CAM acrylate polymer.

Methods: Ten slabs, measuring 15mm x 10mm x 1.5mm, were made of four bis-acrylic composite resin materials, (1) Protemp 4 Temporization Material (3M ESPE), (2) Luxatemp Fluorescence (DMG), (3) Telio CS C&B (Ivoclar) and (4) Integrity (Dentsply); and 1 CAD/CAM acrylate polymer, (5) CAD-Temp (Vita). Slabs were cut from blocks with a saw (Isomet; Buehler). Resin cement plugs measuring 2.3mm in diameter and 5mm in height were made with a jig (Ultradent). The cement was hand mixed, injected into the jig with a disposable syringe (Centrix) and polymerized for 20 seconds with an LED polymerization unit (Bluephase, Ivoclar). Specimens were stored in deionized water (37°C, 1 hour). After storage, shear bond test was performed in a universal testing machine (5566A, Instron) with a 1-kN cell, a 0.5mm/minute cross-head speed and a half-moon shear apparatus. Results were analyzed by ANOVA followed by Tukey HSD test (α = 0.05).

Results: Means and standard deviations of shear bond strength values (MPa) were: (1) 36.41 ± 15.5; (2) 18.35 ± 3.90; (3) 34.21 ± 5.27; (4) 37.70 ± 9.96 and (5) 6.19 ± 2.63. Shear bond strength values for Integrity, Protemp 4 Temporization Material and Telio CS C&B were statistically significantly greater when compared with all other materials. Whereas shear bond strength values for Vita CAD-Temp were statistically significantly lower than all other materials.

Conclusions: Within the limitations of this study, it was concluded that the bond strength of RelyX Unicem Clicker is greater with bis-acrylic materials than with CAD/CAM acrylate polymer.
Protemp™ 4/Plus Temporization Material (cont.)

3M ESPE Summary

Aim of Study: As more and more indications of temporary crown and bridge materials require longer-term durability, it was the aim of this in vitro shear bond strength test to analyze the bond strength of the resin cement RelyX Unicem Self-Adhesive Resin Cement in the Clicker Dispenser to different bisacrylic composite resins as well as one CAD/CAM acrylate material.

Summary of Results: Protemp 4/Plus and two other bisacrylic materials achieved very good bond strength with RelyX Unicem Self-Adhesive Resin Cement. This cement can therefore be recommended for use with Protemp 4/Plus Temporization Material when extra bond strength is needed (e.g. in the case of intermediate restorations).
Protemp™ 4/Plus Temporization Material

Determination of Fracture Toughness of Provisional Dental Materials

Friday, March 23, 2012: 2:00 p.m. – 3:15 p.m.
Location: East Hall (Tampa Convention Center)
Presentation Type: Poster Session
C. LARSEN, M. HARSONO, M. FINKELMAN and R.D. PERRY, Tufts University, Boston, MA

Objectives: To determine and compare the fracture toughness of five provisional dental materials.

Methods: Five groups of ten samples each of provisional materials were tested in this study. The samples were made using a stainless steel mold 2mm in height, 4.95mm in width and 25mm in length. After 24 hours of polymerization, a notch (2.6 ± 0.05mm) was inserted into the middle of each sample using a separating disc (thickness 320μm) attached to an immobilized low speed handpiece. Microscope examination was used to observe any defects. The three-point bending test was performed using a universal testing machine (Instron, 5566A) at a cross-head speed of 1mm/minute (load cell 500 N). The notch was positioned centrally beneath the contact and the distance between the two supports was 20mm. The radius of each support was 1mm. The fracture toughness (K1C) was calculated according to ISO 13586. The Kolmogorov-Smirnov test was used to determine normal distribution and the homogeneity of the samples was checked using the Levene test. A one-way ANOVA was used to test the mean fracture toughness between groups. Statistical significance was predetermined at level p < 0.05.

Results:

<table>
<thead>
<tr>
<th>Group (n = 10)</th>
<th>Material</th>
<th>Mean Fracture Toughness (MPa•m(^{0.5}))</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Structur Premium (Voco)</td>
<td>1.36 ± .14(^b)</td>
</tr>
<tr>
<td>2</td>
<td>Protemp Plus (3M)</td>
<td>1.66 ± .22(^c,d)</td>
</tr>
<tr>
<td>3</td>
<td>Luxatemp (DMG)</td>
<td>1.05 ± .11(^a)</td>
</tr>
<tr>
<td>4</td>
<td>Luxatemp Ultra (DMG)</td>
<td>1.54 ± .17(^c,d)</td>
</tr>
<tr>
<td>5</td>
<td>Experimental (Dentsply Caulk)</td>
<td>1.35 ± .17(^b)</td>
</tr>
</tbody>
</table>

Conclusions: Group 3 exhibited a statistically lower resistance to crack propagation than all other groups, whereas Group 2 exhibited a statistically higher resistance than Group 1, Group 3 and Group 5. No statistical difference is evident between Groups 1, 3 and 5.

This abstract is based on research that was funded entirely or partially by an outside source: Dentsply Caulk.

3M ESPE Summary

Aim of Study: To determine in vitro fracture toughness (resistance to crack propagation) of five different provisional crown and bridge materials.

Summary of Results: Protemp 4/Plus Temporization Material showed the highest fracture toughness of the tested materials.
Support of Prevention of Gingivitis By Temporary Crown and Bridge Materials

Friday, March 23, 2012: 2:00 p.m. – 3:15 p.m.
Location: East Hall (Tampa Convention Center)
Presentation Type: Poster Session
S. HADER¹, C. WIEDIG¹, R. HECHT¹, U. HOHEISEL², M. HAUKE² and I. HAEBERLEIN¹, 13M ESPE AG, Seefeld, Germany, 1R&D, 3M ESPE AG, Seefeld, Germany

Objectives: The Dental Advisor reported in its March 2011 issue, the clinical observation that the temporary crown and bridge material Protemp™ 4 Temporization Material (3M ESPE) supported improvement of very inflamed gingival tissue. The FDA describe in their Guidance for Industry: Gingivitis (2005) a solid correlation between gingivitis and amount of plaque. Aim of the study was to investigate the plaque growth inhibition property of temporary crown and bridge materials in a microcosm plaque model.

Methods: Human saliva was used to grow a microcosm plaque on bovine enamel, Protemp 4 (3M ESPE) and Integrity® (Dentsply) samples (n = 6) each. Plaque growth was initiated via a 1:4 mixture of human saliva and MCM-sucrose-culture media for 4 hours at 37°C; the media was replenished for the next 22 hours at 37°C. Plaque was collected and dried to determine plaque. Biomass was related to the exposed surface area of each specimen.

Results: On the enamel bovine reference samples an average plaque mass of 1.93 ± 0.51 mg/cm² has been found. Substantially less plaque accumulated on Protemp 4 (0.92 ± 0.35 mg/cm²) which is statistically significantly different (p < 0.05, Two-Sample T-Test) to the plaque mass grown on bovine enamel and on Integrity® (1.46 ± 0.27 mg/cm²). The plaque accumulation on bovine enamel and Integrity® was not statistically significantly different (p > 0.05).

Conclusions: Protemp 4 Temporization Material shows a statistically significant better plaque resistance than enamel which can be considered as first rationale for the dentist's clinical observation that Protemp 4 seems to contribute to prevent gingivitis. Further investigations have been initiated to leverage understanding of the gingivitis preventive effect of temporary crown and bridge materials.

3M ESPE Summary

Aim of Study: To investigate the ability of two temporary crown and bridge materials to inhibit plaque growth compared to natural enamel in a microcosm plaque model.

Summary of Results: Protemp 4/Plus Temporization Material showed significantly better plaque resistance than enamel in this in vitro model. As the amount of plaque growth is seen to be related to the development of gingivitis (FDA 2005), it can be concluded that materials like Protemp 4/Plus Temporization Material can help to reduce the risk of gingivitis. This in vitro finding has been confirmed in clinical observations.
Protemp™ 4/Plus Temporization Material

Long-Term Stability of Chairside, Implant-Supported Restorations Fabricated with Bis-Acrylic Composite

Friday, June 22, 2012: 3:45 p.m. – 5:00 p.m.
Location: Poster Hall (Tampa Convention Center)
Presentation Type: Poster Session
S. OLIVEIRA¹, A.C. SELEM², G. RIBEIRO³, S.M. MORGANO³ and C.E. SABROSA¹, ¹Universidade do Estado do Rio de Janeiro, Rio de Janeiro, Brazil, ²Universidade Do Estado do Rio de Janeiro, Jacarepaguá, Brazil, ³Boston University, Boston, MA

Introduction: Bis-acrylic composite resin is durable and esthetic and this material appears to be promising for the fabrication of long-lasting interim restorations.

Objectives: To assess long-term durability of screw-retained, implant-supported restorations fabricated chairside from a bis-acrylic composite resin (Protemp 4 Temporization Material, 3M ESPE). Variables investigated were wear, gingival health and maintenance of luster.

Methods: Two adult patients in need of single implant-supported crowns were selected for this clinical trial. After the informed consent of the patients, diagnostic casts were fabricated and diagnostic waxings of the selected teeth were made. After initial diagnosis and treatment planning, the involved teeth (3 per patient) were extracted and an implant (Replace Select Tapered, Nobel Biocare) was immediately placed at each extraction site. Implants were immediately placed in function with screw-retained restorations. Implant-supported crowns were made by using a poly-vinyl siloxane impression material (Express™ VPS Impression Material XT, 3M ESPE) matrix prior to tooth extraction that also served as a guide for implant placement. After pick-up of the temporary components, restorations were carved for optimal occlusal and proximal contacts as well as to allow soft-tissue healing. Recalls were made at 1, 3, 6 and 12 months and every 6 months thereafter for up to 3.5 years. Performance of the restorations was evaluated with clinical examination and photographic documentation. Clinical handling and patient satisfaction were documented also at each recall.

Results: There were no recorded failures for up to 42 months. Overall satisfaction was very high. Restorations did not stain or lose their luster, and the periodontal condition was favorable.

Conclusions: Within the limitations of this observation, it was concluded that the direct technique may be a viable treatment option when using bis-acrylic composite resin materials to fabricate implant-supported restorations. Protemp 4 Temporization Material performed well after 42 months.

3M ESPE Summary

Aim of Study: To document long-term survival of implant supported Protemp 4/Plus interim restorations fabricated chairside with a focus on wear, gingival health and gloss retention.

Summary of Results: The Protemp 4/Plus Temporization Material interim implant supported restorations survived the observation period of 3.5 years maintaining their esthetic appearance (gloss no staining) as well as good gingival health.
# RelyX™ Unicem Self-Adhesive Resin Cement

## Does Long-Term Water-Storage Affect Retentive Strength of Self-Adhesive Cements?

**Thursday, September 1, 2011: 10:30 a.m. – 12:00 p.m.**  
Location: Hall 3 (Theoretical Building of the Semmelweis University)  
Presentation Type: Oral Session  
V. EHLERS, G. KAMPF, E. STENDER, B. WILLERSHAUSEN and C.-P. ERNST, Operative Dentistry, Universitaetsmedizin Mainz, Mainz, Germany

### Objectives:
The retentive strength of seven self adhesive cements (RelyX™ Unicem Self-Adhesive Resin Cement Aplicap™ Capsule, RelyX™ Unicem Clicker Dispenser, RelyX™ Unicem 2 Automix/3M ESPE, iCEM/Heraeus, Maxcem Elite/sds Kerr, Bifix SE/VOCO, SpeedCem/Ivoclar), two self adhesive cements with self etch primers (Panavia 21/Kuraray, Secure/Sun Medical) one glass ionomer-cement (Ketac™ Cem Aplicap™ Permanent Glass Ionomer Luting Cement/3M ESPE), one resin modified glass ionomer-cement (Meron Plus/VOCO) and a zinc-phosphate cement (Harvard) were examined for luting zircon-oxide ceramic crowns (Lava™, 3M ESPE) on extracted human teeth after thermocycling and after one year of water storage.

### Methods:
240 extracted teeth (n = 10) were prepared in a standardized manner (10°, h = 3mm). The resin cements and the adhesive system were used according to manufacturers’ recommendations; in dual-curing systems, only the self-curing approach was conducted. The crowns’ inner surfaces were sandblasted. After thermocycling (5000x, 5–55°C) and one year of water storage, the cemented ceramic crowns (Rocatec™-pretreatment at the outer surface; connected over a low shrinkage epoxy resin to a resin block, made of Paladur denture base material) were removed along the path of insertion using a Zwick universal testing device. Statistical analysis was made using the two-sample Kolmogorov-Smirnov test.

### Results:
The median retentive strength values [N/mm²] for samples thermocycled only (1st number) and samples thermocycled + 1 a of water storage (2nd number) were: Panavia 21: 1.7/2.5, Secure: 3.0/3.0, RelyX Unicem Self-Adhesive Resin Cement Aplicap Capsule: 3.1/3.4, RelyX Unicem Clicker Dispenser: 4.1/4.2, RelyX Unicem 2 Automix Cement: 3.0/3.1, iCEM: 2.3/2.7, Maxcem Elite: 3.0/3.2, Bifix SE: 1.7/1.7, Quickcem: 1.3/1.6, Meron Plus AC: 3.1/2.7, Ketac Cem Aplicap Permanent Glass Ionomer Luting Cement: 1.4/1.4, Zinc phosphate cement: 1.1/1.6. No significant difference was found between the samples thermocycled only and those who underwent an additional one year of water storage (p > 0.2) in any single comparison.

### Measured Values

<table>
<thead>
<tr>
<th></th>
<th>Panavia 21</th>
<th>Secure</th>
<th>iCEM</th>
<th>Maxcem Elite</th>
<th>BiFix SE</th>
<th>Quickcem</th>
<th>Meron Plus AC</th>
<th>Zinc phosphate cement</th>
<th>Ketac Cem Aplicap</th>
<th>RelyX Unicem Aplicap</th>
<th>RelyX Unicem Clicker</th>
<th>RelyX Unicem 2 Automix</th>
</tr>
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<tbody>
<tr>
<td>TC</td>
<td>1.7</td>
<td>3</td>
<td>2.3</td>
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<td>1.3</td>
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<td>TC + 1 year</td>
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</table>

### Standard Deviation

<table>
<thead>
<tr>
<th></th>
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<th>SD 2</th>
<th>SD 3</th>
<th>SD 4</th>
<th>SD 5</th>
<th>SD 6</th>
<th>SD 7</th>
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<tr>
<td>Value 5</td>
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<td>1.2</td>
<td>3.0</td>
<td>1.2</td>
<td>3.0</td>
<td>0.9</td>
<td></td>
</tr>
</tbody>
</table>

continued on next page >
Conclusions: Long term water storage did not affect the retentive strength of self adhesive cements significantly. This study was supported by 3M ESPE, Heraeus, Ivoclar Vivadent, VOCO and Sun Medical.

3M ESPE Summary

Aim of Study: Several conventional cements, self-adhesive and adhesive resin cements were compared in a clinically relevant crown pull-off design after artificial aging of thermocycling and one year water storage.

Summary of Results: After artificial aging, the highest median retentive strengths of all materials tested were shown by the the RelyX Unicem Self-Adhesive Resin Cement materials.
RelyX™ Unicem Self-Adhesive Resin Cement

Four-Year Clinical Evaluation of a Self-Adhesive Luting Agent

Thursday, September 1, 2011: 4:00 p.m. – 5:30 p.m.
Location: Hall 3 (Theoretical Building of the Semmelweis University)
Presentation Type: Oral Session
M. PEUMANS, J. DE MUNCK, K. VAN LANDUYT, A. POITEVIN and B. VAN MEERBEEK, Leuven BIOMAT Research Cluster, Department of Conservative Dentistry, Catholic University of Leuven, Leuven, Belgium

Objectives: The aim of this randomized controlled clinical trial was to evaluate the 4-year clinical performance of a self-adhesive resin cement, RelyX™ Unicem Self-Adhesive Resin Cement (3M ESPE), used for cementation of ceramic inlays. In addition, the influence of selectively acid-etching enamel prior to luting on the clinical performance of the restorations was assessed.

Methods: Sixty-two IPS Empress 2 inlays/onlays were placed in 31 patients by two experienced clinicians. The restorations were luted with RelyX Unicem Self-Adhesive Resin Cement with (= experimental group: E) or without (= control group: NE) prior enamel etching with phosphoric acid. At baseline, 6 months, 1, 2 and 4 years after placement, the restorations were assessed by two calibrated investigators using modified USPHS criteria. Ten selected samples of each group were investigated under SEM regarding morphological changes at the cement-inlay interface.

Results: The recall rate at 4 years was 97%. Two restorations (1 E, 1 NE) were lost and one restoration (E) had to be replaced due to inlay fracture resulting in a survival rate of 95%. No significant differences between the experimental and control group were noticed regarding all criteria except for colour match (McNemar, p < 0.05). An obvious deterioration in marginal integrity was observed after 4 years as only 5% (E = 7%; NE = 3%) of the restorations exhibited an excellent marginal adaptation. In 90% of the restorations small, still clinically acceptable marginal deficiencies were observed. SEM of the luting gap showed an increased wear of the RelyX Unicem Self-Adhesive Resin Cement over the 4-year period.

Conclusions: The self-adhesive luting cement RelyX Unicem Self-Adhesive Resin Cement can be recommended for bonding of ceramic inlays/onlays. Additional selective enamel etching does not improve the clinical performance of the restorations within the 4-year period.

3M ESPE Summary

Aim of Study: This controlled clinical trial compared the performance of RelyX Unicem Self-Adhesive Resin Cement when used either self-adhesively without or with prior selective enamel etching for the cementation of glass ceramic inlays and onlays.

Summary of Results: After four years in clinical service, the authors conclude that RelyX Unicem Self-Adhesive Resin Cement can be recommended for bonding of ceramic inlays/onlays. Additional selective enamel etching does not improve the clinical performance of the restorations within the 4-year period.
RelyX™ Unicem Self-Adhesive Resin Cement

Impact of Marginal Findings on Complications in Zirconia-Based Crowns

Friday, September 2, 2011: 8:00 a.m. – 5:30 p.m.
Location: Poster Hall (Theoretical Building of the Semmelweis University)
Presentation Type: Poster Session
F. HUETTIG, Dept.of Prosthodontics, University of Tubingen, Tuebingen, Germany, C. MESMER, Dental Clinic, University of Tubingen, Tuebingen, Germany and M. GROTEN, Dept. of Prosthodontics, University of Tubingen, Tuebingen, Germany

Objectives: Evaluation of the marginal integrity and its impact on complications in a clinical followed-up and growing cohort.

Methods: 37 patients were treated with 82 Zirconia-based single tooth crowns on natural teeth. The Zirconia frameworks were CAM-fabricated (Cercon Smart Ceramics, Degudent) and veneered with a glass-ceramic material (Cercon Kiss, Degudent) in layering technique. Luting protocol was conventional mostly with self-adhesive universal resin cement. Clinical follow-up examinations consisted of a complete dental and hygiene status and a clinical quality assessment according to modified CDA-criteria. Due to a loss to follow up of 4 patients, 77 restorations (36 anterior, 41 posterior) were investigated and evaluated.

Results: During a mean observation time of 27 months (range 1 to 81, median 21 months), 8 constructions experienced complication (10.4%) affecting four patients. The quality was ranked by according to CDA-scheme: R (excellent) = 56, S (acceptable ) = 12, T (problematic) = 6 and V (failed) = 3. Ranking included historical adverse events of technical (i.e. chip-off) or biological (i.e. caries, endodontic problem) nature as well as findings at marginal integrity (probing for gap formation, discoloration). Marginal integrity rated 76 crowns as satisfactory (R = 65, S = 11) and 1 crown “T” to correct for prevention. This misfit denotes 1 out of 77 crowns as “not acceptable”, but was already found at baseline and might be a luting mistake. It changes the complication rate to 11.7% (9 out of 77).

Conclusions: CAM fabricated Zirconia-based crowns showed clinically perfect marginal quality, without impact on overall survival. Nevertheless, clinical short-term performance is compromised by technical complications of the veneering ceramic.

3M ESPE Summary

Aim of Study: In this clinical observation, marginal integrity and clinical survival of zirconia (Cercon Check™) crowns cemented with RelyX Unicem Self-Adhesive Resin Cement are evaluated.

Summary of Results: After a mean observation time of more than 2 years, 76 out of 77 crowns cemented with RelyX Unicem Self-Adhesive Resin Cement had satisfactory marginal integrity. Only one crown needed correction already at baseline, which the authors attributed to a potential luting mistake.
RelyX™ Ultimate Adhesive Resin Cement

Shear-Bond Strength of Adhesive Resin Cements to Enamel and Dentin

Saturday, September 3, 2011: 8:00 a.m. – 12:30 p.m.
Location: Poster Hall (Theoretical Building of the Semmelweis University)
Presentation Type: Poster Session
C. WIEDIG, R. HECHT, G. RAIA, M. LUDSTECK and R. GUGGENBERGER, 3M ESPE, Seefeld, Germany

Objectives: The purpose of this in-vitro investigation was to compare shear bond strength (SBS) of different adhesive resin cements and their dedicated adhesives to bovine enamel and dentin.

Methods: Materials tested were Multilink® Automix/Multilink® Primer A/B (Ivoclar-Vivadent), Panavia™ F2.0/ED Primer II (Kuraray), NX3/OptiBond Solo™ plus (Kerr), Clearfil™ Esthetic Cement/DC Bond (Kuraray), Experimental Cement/Experimental Adhesive (3M ESPE).

Bovine teeth were ground flat to expose enamel or dentin, polished (grit 320 sandpaper), water-rinsed and gently air-dried. Dedicated adhesive systems were applied according to the manufacturers’ instructions. Stainless steel rods were cemented under pressure (20 g/mm²) onto the teeth and light cured. Specimens were stored for 24 hours at 36°C and 100% relative humidity. Half of the specimens were artificially aged (5,000 thermo cycles, 5°C–55°C, 30 seconds dwell time). SBS was measured using a universal testing machine (Zwick Z010, crosshead speed: 0.75mm/minute). Data obtained were analyzed using Multiple Range Test (Fisher’s LSD; p < 0.05; n = 6).

Results: Statistical analysis revealed significant differences between the tested adhesive resin cements depending on tooth surface and storage/aging conditions (see table). Values in one column with different superscript characters are statistically different.

<table>
<thead>
<tr>
<th>Material</th>
<th>SBS Dentin lc 24h [MPa]</th>
<th>SBS Dentin lc TC [MPa]</th>
<th>SBS Enamel lc 24h [MPa]</th>
<th>SBS Enamel lc TC [MPa]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Multilink Automix/Primer A&amp;B</td>
<td>13.9 ± 2.7b</td>
<td>7.6 ± 4.6a</td>
<td>29.1 ± 5.5b</td>
<td>25.4 ± 9.7a</td>
</tr>
<tr>
<td>Panavia F2.0/ED Primer II</td>
<td>26.8 ± 7.5c</td>
<td>26.5 ± 2.7b</td>
<td>40.2 ± 10.1b</td>
<td>39.6 ± 10.6b</td>
</tr>
<tr>
<td>NX3/OptiBond Solo Plus</td>
<td>8.2 ± 1.913</td>
<td>9.3 ± 2.5a</td>
<td>15.5 ± 4.8a</td>
<td>17.8 ± 5.4a</td>
</tr>
<tr>
<td>Clearfil Esthetic Cement/DC Bond</td>
<td>6.5 ± 3.84</td>
<td>9.7 ± 4.4a</td>
<td>44.3 ± 8.01</td>
<td>50.8 ± 9.4a</td>
</tr>
<tr>
<td>Exp.Cement/Exp. Adhesive</td>
<td>27.5 ± 9.7i</td>
<td>54.2 ± 8.3i</td>
<td>51.2 ± 8.81</td>
<td>54.5 ± 7.0i</td>
</tr>
<tr>
<td>Exp.Cement/Exp. Adhesive/Etch</td>
<td>52.4 ± 3.9i</td>
<td>65.3 ± 10.2i</td>
<td>54.8 ± 7.9i</td>
<td>67.3 ± 8.4i</td>
</tr>
</tbody>
</table>

continued on next page >
Conclusions: The experimental resin cement and its dedicated adhesive system show best overall adhesion performance to enamel and dentin under all testing conditions.

3M ESPE Summary

Aim of Study: A new versatile and simplified adhesive resin cement was analyzed regarding its adhesion to dentin and enamel.

Summary of Results: RelyX Ultimate Adhesive Resin Cement and its simplified adhesive system showed best overall adhesion performance in this test, both after 24 hours and after artificial aging and both when used in self-etch and in etch and rinse mode.
RelyX™ Ultimate Adhesive Resin Cement

Shear-Bond Strength of Adhesive Resin Cements to Different Restoration Materials

Friday, March 23, 2012: 8:00 a.m. – 9:30 a.m.
Presentation Type: Oral Session
C.A. WIEDIG, R. HECHT, G. RAIA, M. LUDSTECK and C. THALACKER, 3M ESPE AG, Seefeld, Germany

Objectives: The purpose of this in-vitro investigation was to compare shear bond strength (SBS) of different adhesive resin cements and their pre-treatment procedures to Titanium, Ni-Cr-Alloy (Remanium®) and Resin Nano Ceramic (RNC, Lava™ Ultimate Restorative).

Methods: Materials tested were Multilink® Automix, Variolink®II (both Ivoclar-Vivadent), Panavia™ F2.0, Clearfil™ Esthetic Cement (both Kuraray), NX3 (Kerr), RelyX™ Ultimate Adhesive Resin Cement (3M ESPE).

For shear bond strength (SBS) testing, Titanium, Remanium and RNC specimens were pre-treated as recommended by manufacturers’ instructions. Stainless steel rods (diameter 4mm) were cemented under standardized pressure (20 g/mm²) onto the restoration material specimens and light-cured (RNC) or dark-cured (Titanium, Remanium) following the manufacturers’ instructions. RelyX Ultimate was used with Scotchbond™ Universal Adhesive (3M ESPE) that serves both as tooth bonding agent and restoration primer. Specimens were stored for 24 hours at 36°C and 100% relative humidity. Half of the specimens were artificially aged (5,000 thermal cycles, 5°C–55°C, 30 seconds dwell time). SBS was measured using a universal testing machine (Zwick Z010, crosshead speed: 0.75mm/minute). Data obtained were analyzed using Multiple Range Test (Fisher’s LSD; p < 0.05; n = 6).

Results: See table. Values in one column marked with the same superscript characters are not statistically different.

<table>
<thead>
<tr>
<th>Composite Type</th>
<th>Fmax(N) 1s, 8mm/s</th>
<th>Fmax(N) 20s, 1mm/s</th>
<th>Work(N-mm) 1s, 8mm/s</th>
<th>Work(N-mm) 20s, 1mm/s</th>
<th>Composite Type</th>
<th>Instrument Stringiness</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clearfil Esthetic Cement/AlloyPrimer</td>
<td>9.8 ± 1.7a</td>
<td>38.5 ± 8.9b</td>
<td>9.5 ± 4.7a</td>
<td>28.1 ± 5.8b</td>
<td>n.d.</td>
<td>n.d.</td>
</tr>
<tr>
<td>Multilink Automix/Monobond Plus</td>
<td>38.1 ± 5.2c</td>
<td>36.7 ± 4.4c</td>
<td>35.9 ± 3.7c</td>
<td>27.1 ± 3.3c</td>
<td>29.5 ± 5.3c</td>
<td>44.9 ± 8.4b</td>
</tr>
<tr>
<td>Panavia F2.0/-/-/ClearfilCeramicPrimer</td>
<td>32.1 ± 2.3c</td>
<td>42.7 ± 8.5c</td>
<td>34.0 ± 2.9f</td>
<td>24.2 ± 6.4f</td>
<td>34.8 ± 6.1a,b</td>
<td>41.3 ± 7.1a,b</td>
</tr>
<tr>
<td>NX3/-/-/Silane Primer</td>
<td>31.6 ± 3.4c</td>
<td>19.9 ± 1.1a</td>
<td>25.5 ± 3.6p</td>
<td>15.2 ± 1.9a</td>
<td>38.6 ± 5.3c</td>
<td>47.2 ± 8.7c</td>
</tr>
<tr>
<td>RelyX Ultimate/Scotchbond Universal</td>
<td>52.1 ± 5.8d</td>
<td>50.9 ± 3.0d</td>
<td>44.3 ± 3.3d</td>
<td>42.0 ± 6.4e</td>
<td>45.3 ± 4.6c</td>
<td>51.2 ± 6.8c</td>
</tr>
<tr>
<td>Variolink II/Monobond Plus</td>
<td>n.d.</td>
<td>n.d.</td>
<td>n.d.</td>
<td>n.d.</td>
<td>36.7 ± 4.5p</td>
<td>34.3 ± 8.8d</td>
</tr>
<tr>
<td>RelyX Ultimate/RelyX Ceramic Primer</td>
<td>n.d.</td>
<td>n.d.</td>
<td>n.d.</td>
<td>n.d.</td>
<td>48.9 ± 6.0c</td>
<td>44.5 ± 8.5d</td>
</tr>
</tbody>
</table>

Conclusions: RelyX Ultimate Adhesive Resin Cement and its dedicated pre-treatment protocol with Scotchbond Universal adhesive shows highest adhesion values to all tested restoration materials.

3M ESPE Summary

Aim of Study: Modern adhesive resin cements need to adhere strongly to tooth substance as well as to a wide range of restoration materials. Adhesion to restoration materials of the new RelyX Ultimate Adhesive Resin Cement was compared to several other resin cements available.

Summary of Results: Using its bonding agent Scotchbond Universal Adhesive as a universal restoration primer, RelyX Ultimate Adhesive Resin Cement achieves highest bond strengths to all tested restoration materials, self-cured to titanium and non-precious alloy and light cured to Lava Ultimate resin nanoceramics.

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http://iadr.confex.com/iadr/2012tampa/webprogram/
RelyX™ Luting Plus Automix Resin Modified Glass Ionomer Cement

Excess Cement Clean-Up of Novel Resin-Modified Glass-Ionomer Cement: Tack Light-Cure Option

Friday, March 23, 2012: 2:00 p.m. – 3:15 p.m.
Presentation Type: Poster Session
A. FALSAFI¹, T. TRAN¹, Y. WANG¹, T. TON¹ and J. OXMAN², ¹3M ESPE Dental Products, Saint Paul, MN, ²3M ESPE, St. Paul, MN

Objectives: Desirable handling characteristics of dental cements are of significant importance to the dentists. This study investigated several key properties of RelyX™ Luting Plus Automix Resin Modified Glass Ionomer Cement (RLP-AMX, 3M ESPE), a new automix resin-modified glass-ionomer (RMGI) cement, including the ease and speed of excess cement clean-up. RLP-AMX is a multi-dose paste/paste system that offers a tack light-cure option for faster excess cement removal.

Methods: 135 dentists that utilized different cements in their practice were asked to evaluate several handling and clinical characteristics associated with the new cement in a clinical trial conducted by an independent agency. The cement was used according to manufacturer’s directions. Dentists were given two choices on the cement excess clean-up: traditional 2 minute wait, or 5 second tack-light-cure of the cement on each side. Dentists rated performance criteria for excess cement removal and the speed of clean-up.

Results: Responses were analyzed for each characteristic and summarized in tables below. Additional data showed about 1% post-op sensitivity and overall satisfaction greater than 90%.

<table>
<thead>
<tr>
<th>Ease of Excess-Cement Removal, % dentists</th>
<th>Self-Cure Mode</th>
<th>Tack Light-Cure Mode</th>
</tr>
</thead>
<tbody>
<tr>
<td>Very Easy</td>
<td>37</td>
<td>34</td>
</tr>
<tr>
<td>Easy</td>
<td>42</td>
<td>40</td>
</tr>
<tr>
<td>Neutral</td>
<td>13</td>
<td>10</td>
</tr>
<tr>
<td>Difficult, but acceptable</td>
<td>3</td>
<td>5</td>
</tr>
<tr>
<td>Very difficult, not acceptable</td>
<td>2</td>
<td>1</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Faster and easier excess cement clean-up for tack light-cure option, % dentists</th>
</tr>
</thead>
<tbody>
<tr>
<td>Strongly Agree</td>
</tr>
<tr>
<td>Agree</td>
</tr>
<tr>
<td>Neutral</td>
</tr>
<tr>
<td>Disagree</td>
</tr>
</tbody>
</table>

Conclusions: Chi-Square and Confidence Interval tests for one and two proportions were performed. Data for the ease of clean-up showed no statistical difference between the proportions of dentists who found the self-cure option easy/very easy, versus the number of dentists who found the tack light-cure option easy/very easy. (Using a t-test for two proportions, p = 0.59). Calculating a 95% Confidence Interval based on this data, it’s estimated that 71—85% of all dentists would find that the light-cure option provides a faster excess cement clean-up.

3M ESPE Summary

Aim of Study: This study evaluated a new automixed resin reinforced glass ionomer (RMGI) cement, RelyX Luting Plus Automix Resin Modified Glass Ionomer Cement, in clinical practice.

Summary of Results: Excess cement removal is a critical step in everyday clinical routine. A novel tack light cure feature in the tested new RelyX Luting Plus Automix Resin Modified Glass Ionomer Cement makes easy excess removal now also faster. This was observed by almost 80% of the 135 clinical testers.

Results found in abstracts for RelyX™ Luting Plus Automix Resin Modified Glass Ionomer Cement also apply to RelyX™ Luting 2 Cement and Ketac™ Cem Plus Luting Cement.

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http://iadr.confex.com/iadr/2012tampa/webprogram/
Innovative Colour-Matched Multi-Purpose Resin-Based Cementation System Evaluated by General Practitioners

R.J. CRISP and F.T. BURKE, School of Dentistry, University of Birmingham, Birmingham, United Kingdom

Objectives: To assess handling properties of a new shade-matched dual-cure adhesive resin cement suitable for self-etching and total-etching/etch and rinse procedures (Suglue-10, 3M ESPE, Seefeld, Germany) and its delivery system.

Methods: Ten UK general dental practitioner members of the practice-based research group, The PREP Panel, received four different shaded syringes, the novel bonding-agent, dispensing tips and instructions for use for two-months. A questionnaire was designed to evaluate current resin-based cementation usage and to rate the presentation, instructions, dispensing and handling of the new material. Most responses were on a visual analogue scales (VAS).

Results: All evaluators (100%) previously used a resin-based cementation system, six (60%) also used a ‘conventional’ system. The main reasons for choice of cementation materials were ease of use and reliability. With 98 restorations placed, the test material scored similarly for ease of use to the previously used resin-based material (4.2 v 4.4 on a VAS where 1 = difficult to use and 5 = easy to use). The new material was scored ideal for viscosity and also for dispensing and handling (4.9 on a VAS where 1 = inconvenient & 5 = convenient). 80% (n = 8) of the evaluators stated the available shades were sufficient and 60% (n = 6) used the try-in pastes. 90% (n = 9) of the evaluators agreed that it was both a clinical advantage a) to use the same luting material for all indications, including cementation of zirconia restorations and b) for the ability of the bonding agent to bond to tooth and be a silane and restoration primer. 80% (n = 8) of the evaluators would both purchase the new cementation system and recommend it to colleagues.

Conclusions: The new resin-based shade-matched adhesive cementation material and its delivery system performed well in this handling evaluation with high scores handling and ease of use.

This abstract is based on research that was funded entirely or partially by an outside source: 3M ESPE, Seefeld, Germany

3M ESPE Summary

Aim of Study: This study evaluated a new adhesive resin cement, RelyX™ Ultimate Adhesive Resin Cement, in clinical practice.

Summary of Results: RelyX Ultimate Adhesive Resin Cement in the automix syringe delivery performed very well in this clinical handling evaluation, especially regarding ease of use. 80% of testers would use the material.
Retention of Zirconia Crowns Bonded With Adhesive Resin Cements

Q. CAI, D. CAKIR, P. BECK, L. RAMP and J. BURGESS, University of Alabama at Birmingham, Birmingham, AL

Objectives: To measure retention of zirconia crowns cemented with an experimental (3M ESPE) and 2 commercially available (Multilink Automix/Ivoclar, Panavia F2.0/Kuraray) cements under different surface preparation conditions (Table).

Methods: 50 extracted teeth (n = 10) were embedded in brass holders and placed into a lathe to produce a uniform crown preparation (20 degree taper and 3mm height). An orientation groove was placed on the occlusal surface using a round bur and high-speed handpiece. Preparations were scanned using Lava™ Chairside Oral Scanner C.O.S. (3M ESPE) and the file sent to 3M ESPE Professional Lab where Lava™ Zirconia copings were milled. Each preparation was imaged with a digital microscope (Keyence/VHX-600) at 20X magnification to measure surface areas and calculate strength by dividing the failure load with bonded surface area. Finished crowns were fit to the preparation, margins checked for opening and fit (explorer does not catch). Crowns were randomly assigned to 5 groups (Table) and cemented following manufacturers’ instructions. A 2kg weight was placed on the crown during cementation. Margins were light cured. (Elipar™ S10 LED Curing Light/3M ESPE/1100mW/cm²). Specimens were stored (distilled water/37°C/24 hour), thermocycled (5–55°C/10,000cycles/15 seconds dwell time) and load cycled using an acetyl stylus (20N/100,000cycles/1.2Hz). A metal rod was placed through the hole on the coping and attached to the upper member of an INSTRON (Model/5565) and loaded in tension (5mm/minute) until debonding. Data were analyzed with ANOVA and Tukey/Kramer (p = 0.05).

Results: (Mean ± SD)

<table>
<thead>
<tr>
<th>Materials/Manufacturer</th>
<th>Load (N)</th>
<th>Stress (PMa)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Exp. Cement/Sandblasted/50μ-Al203</td>
<td>599.9 ± 147.8</td>
<td>5.4 ± 1.3</td>
</tr>
<tr>
<td>Exp. Cement/Sandblasted: 50μ-Al203/Primed</td>
<td>716.6 ± 110.5</td>
<td>6.5 ± 1.2</td>
</tr>
<tr>
<td>Exp. Cement/Sandblasted: 50μ-Al203+30μ-CoJet/Primed</td>
<td>635.2 ± 210</td>
<td>5.1 ± 1.6</td>
</tr>
<tr>
<td>Multilink Automix/Sandblasted/50μ-Al203/Ivoclar Vivadent</td>
<td>393.3 ± 158.2</td>
<td>3.4 ± 1.4</td>
</tr>
<tr>
<td>Panavia F2.0/Sandblasted/50μ-Al203/Kuraray</td>
<td>446.8 ± 134</td>
<td>3.8 ± 1</td>
</tr>
</tbody>
</table>

Conclusions: Multilink had lower retention compared to all experimental material groups (p < 0.05). Difference in retention was also found for Panavia F2.0 and Experimental cement when applied on sandblasted and primed surface. Supported by a grant from 3M ESPE.

3M ESPE Summary

Aim of Study: This study investigated the retentive strength of new RelyX Ultimate Adhesive Resin Cement compared to other resin cements when cementing zirconia crowns on non-retentively prepared abutment teeth.

Summary of Results: RelyX Ultimate Adhesive Resin Cement with Scotchbond Universal Adhesive showed highest bond strength in this clinically relevant test.
RelyX™ Ultimate Adhesive Resin Cement

Adhesion of Indirect Ceramic and Composite Restorations: Influence of Chewing

G. TURCO, A. FRASSETTO, G. MARCHESI, I. SPAGNOLO, C. NAVARRA, R. DI LENARDA, M. CADENARO and L. BRESCHI, Department of Medical Sciences, University of Trieste, Trieste, Italy

Objectives: The purpose of this study was to evaluate the influence of simulated chewing forces on bond strength of ceramic and composite disks luted to dentin with a simplified cement (Scotchbond™ Universal Adhesive and RelyX™ Ultimate Adhesive Resin Cement, 3M ESPE) or a multi-step cement (Variolink II, Ivoclar-Vivadent).

Methods: Eighty noncarious human molars were cut with a low speed diamond saw under water cooling and equally and randomly assigned to two main groups: CS (Chewing Simulation) and Controls (Static Conditions). Specimens were then divided in 4 different luting groups (N = 20): Group 1: Ceramic disks (Feldspathic Ceramic, Vita Mark II, Vita) luted with Scotchbond Universal Adhesive and RelyX Ultimate Adhesive Resin Cement; Group 2: Ceramic disks (Feldspathic Ceramic, Vita Mark II) luted with Variolink II; Group 3: Composite disks (Lava™ Ultimate Restorative, 3M ESPE) and Scotchbond Universal Adhesive and RelyX Ultimate Adhesive Resin Cement; Group 4: Composite disks (Lava Ultimate Restorative) and Variolink II. Specimens were then either submitted to chewing simulation or stored in water and subsequently cut for microtensile bond strength analysis in accordance with the non-trimming technique. Sticks were stressed until failure with a simplified universal testing machine. Data were statistically analyzed by Student’s T Test (p = 0.05).

Results: Means and standard deviations (SD) of microtensile bond strength (MPa) obtained at luted material/dentin interface. Different superscript letters indicate statistical differences between the groups (p < 0.05).

<table>
<thead>
<tr>
<th>Luted Material</th>
<th>Cement</th>
<th>Storage</th>
<th>CS</th>
<th>Control</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ceramic</td>
<td>SU and RU</td>
<td>12.1 (4.4)a</td>
<td>14.3 (4.7)xyz</td>
<td></td>
</tr>
<tr>
<td></td>
<td>VII</td>
<td>13.5 (4.7)ab</td>
<td>16.1 (4.3)c,d</td>
<td></td>
</tr>
<tr>
<td>Composite</td>
<td>SU and RU</td>
<td>12.6 (4.7)ab</td>
<td>13.2 (5.3)ab</td>
<td></td>
</tr>
<tr>
<td></td>
<td>VII</td>
<td>14.9 (5.3)abc</td>
<td>17.8 (5.1)d</td>
<td></td>
</tr>
</tbody>
</table>

Conclusions: The simplified luting procedure (Scotchbond Universal Adhesive and RelyX Ultimate Adhesive Resin Cement) exhibited comparable bond strength values for both ceramic and composite irrespective from the aging conditions (both CS and Static). Albeit the strength values were slightly higher before chewing simulation, the multi-step cement (Variolink II) was significantly affected by chewing. Further studies are needed to clarify the role of occlusal forces on ceramic bond to dentin.

3M ESPE Summary

Aim of Study: To compare the bond strength of the new, simplified adhesive resin cement RelyX Ultimate Adhesive Resin Cement used in the self-etch technique, to the etch and rinse multistep resin cement Variolink II/Syntac.

Summary of Results: RelyX Ultimate Adhesive Resin Cement with Scotchbond Universal Adhesive using a simplified luting protocol showed similar bond strength as the multistep etch and rinse system Syntac/Variolink II, however using only two system components versus seven in the tested procedure. The restoration materials did not significantly influence the bond strengths in this test.
RelyX™ Unicem 2 Automix Self-Adhesive Resin Cement

Effectiveness of Adhesive Resin Cements Bonded Under Simulated Pulpal Pressure

Thursday, June 21, 2012: 3:45 p.m. – 5:00 p.m.
Location: Poster Hall (Convention Center)
Presentation Type: Poster Session
N. SARTORI, University of Southern Santa Catarina, Tubarao, Santa Catarina, Brazil, L. DALLMAGRO PERUCHI, University of Southern California, São Jose, Santa Catarina, Brazil, J. PHARK, Herman Ostrow School of Dentistry — Divison of Restorative Sciences, University of Southern California, Los Angeles, CA and S. DUARTE, Division of Restorative Sciences, University of Southern California, Los Angeles, CA

Objectives: To investigate microtensile bond strengths (μTBS) and nanoleakage at adhesive interface of four adhesive luting systems bonded to dentin under simulated pulpal pressure.

Methods: 36 recently extracted molars were selected and processed for dentin μTBS. The selected teeth were randomly assigned into 12 experimental groups according to the adhesive luting system [RelyX™ ARC Adhesive Resin Cement (3M ESPE), warmed Filtek™ Z250 Universal Restorative (3M ESPE), RelyX Unicem 2 (3M ESPE) and Clearfil Esthetic (Kuraray)] and simulated pulpal pressure (0, 5 and 20cm). Lithium-disilicate ceramic blocks (IPS Empress CAD, Ivoclar Vivadent) were processed and bonded to dentin. The samples were sectioned in X/Y directions to obtain specimens with a cross section of 0.8 ± 0.2mm². All sticks were fractured by tension at a crosshead speed of 1.0mm/minute and the data were submitted to Kruskal-Wallis and Mann-Whitney Tests (= .05). Additionally, representative specimens were processed for nanoleakage using CLSM.

Results: (Pre-testing failure/number of specimens) Mean ± SD in MPa.

<table>
<thead>
<tr>
<th>Pulpal Pressure</th>
<th>(PTF/n) 0cm</th>
<th>(PTF/n) 5cm</th>
<th>(PTF/n) 20cm</th>
</tr>
</thead>
<tbody>
<tr>
<td>RelyX ARC</td>
<td>(0/78) 18.13 ± 7.0³⁴</td>
<td>(77/86) 17.68 ± 7.6³⁴</td>
<td>(33/86) 10.50 ± 6.9³⁴</td>
</tr>
<tr>
<td>Warmed Z250</td>
<td>(0/78) 35.58 ± 10.3³⁴</td>
<td>(15/61) 20.64 ± 11.7³⁴</td>
<td>(25/66) 16.19 ± 11.5³⁴</td>
</tr>
<tr>
<td>Clearfil Esthetic</td>
<td>(0/79) 19.23 ± 7.9³⁴</td>
<td>(21/68) 14.35 ± 10.1³⁴</td>
<td>(12/92) 15.21 ± 8.1³⁴</td>
</tr>
<tr>
<td>RelyX Unicem 2</td>
<td>(0/92) 19.52 ± 8.1³⁴</td>
<td>(0/77) 18.50 ± 6.1³⁴</td>
<td>(6/71) 15.06 ± 7.5³⁴</td>
</tr>
</tbody>
</table>

Means with same lower-case letters, in the same row, are not statistically different.
Means with same upper-case letters, in same column, are not statistically different.

CLSM images showed that nanoleakage increased significantly as the simulated pulp pressure increased. Water blisters were found at the adhesive interface with pulpal pressure of 20cm, revealing severe water degradation of the adhesive interfaces.

Conclusions: Pulpal pressure significantly reduced μTBS and increased hydrolysis of adhesive resin cements.

3M ESPE Summary

Aim of Study: Investigation of nanoleakage and microtensile bondstrength at the adhesive interface of different adhesive luting systems under simulated pulpal pressure.

Summary of Results: While all cementation systems decreased in microtensile bondstrength under increasing pulpal pressure the self adhesive resin cement RelyX Unicem 2 was found to have the most stable results under the test conditions. All cements seem to have shown some nanoleakage.
Objectives: To evaluate the effect of photo-activation protocol (PAP) and resin cement type (Rc) on the mechanical properties and bond strength (BS) of fiber posts (FP) to root dentin at depths.

Methods: RU, RelyX Unicem Self-Adhesive Resin Cement (3M ESPE), BC, Biscem (Bisco), PF, Panavia F (Kuraray) and RA, RelyX™ ARC Adhesive Resin Cement (3M ESPE) were used to cement FP in association with one of the three PAP: light-curing immediate, 3 minutes and 5 minutes after to cement FP. In each group 10 posted root were used for push-out test obtaining 2 slices for root region: cervical, middle and apical. For indentation test, 3 roots per group were sectioned longitudinally through FP and modulus of elasticity (E) and Vicker’s hardness (VHN) of the along all cement layer were assessed using dynamic indentation. Data were analyzed with ANOVA and Tukey’s test and multiple linear regression.

Results: BS values are shown in Table 1. E and VHN mean values increased significantly with delayed PAP for self-adhesive, these parameters decreased from coronal to apical root thirds for all Rc.

Table 1 — Means ± stand deviation PS in MegaPascal.

<table>
<thead>
<tr>
<th>Root Third</th>
<th>Immediate</th>
<th>3 minutes</th>
<th>5 minutes</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>RU</td>
<td>BC</td>
<td>PF</td>
</tr>
<tr>
<td>Cervical</td>
<td>9.7±3.8ab</td>
<td>10.6±2.7ac</td>
<td>7.8±1.8ab</td>
</tr>
<tr>
<td>Middle</td>
<td>7.3±2.7bc</td>
<td>7.1±1.6bc</td>
<td>6.0±1.4bc</td>
</tr>
<tr>
<td>Apical</td>
<td>6.0±2.7bc</td>
<td>5.8±1.7bc</td>
<td>4.6±1.0bc</td>
</tr>
</tbody>
</table>

Different letters (Greek letters, comparison among rows in each Rc to PAP; capital letters, comparison among rows in each PAP; lower case letter, comparison among columns) indicate statistical difference (p < 0.05).

Conclusions: Delayed PAP increased BS, E and VHN values for self-adhesive Rc used to cement FP. The root canal region is a critical factor for the BS, E and VHN of dual-cure Rc photo-activated using different protocols.
RelyX™ Unicem Self-Adhesive Resin Cement

3M ESPE Summary

Aim of Study: To determine the effect of delayed light curing on the bond strength, elastic modulus and Vickers hardness of different dual cure cement systems used to cementing fiberposts.

Summary of Results: For self adhesive resin cements including RelyX Unicem Self-Adhesive Resin Cement delayed light curing significantly increased Vickers hardness and elastic modulus and generally for all cements coronal values measured were higher than apical values. Bond strength also increased with delayed light curing protocols. Again coronal values were generally higher than apical values. Overall RelyX Unicem Self-Adhesive Resin Cement showed the highest bond strength values for any given curing protocol and any given rooth depth.
RelyX™ Unicem 2 Automix Self-Adhesive Resin Cement

Isothermal Conversion of Dual-Cured Resin Cements in Self-Cure Mode

Friday, June 22, 2012: 3:45 p.m. — 5:00 p.m.
Location: Poster Hall (Convention Center)
Presentation Type: Poster Session
C. AZEVEDO, Campinas State University, Piracicaba, Brazil, M.F. DE GOES, Restorative Dentistry, Piracicaba Dental School — University of Campinas, Piracicaba, SP, Brazil and F. RUEGGEBERG, Dental Materials, Georgia Health Sciences University, Augusta, GA

Objectives: To determine the effect of isothermal curing conditions on the self-polymerization of dual-cured resin cements at 1 hour from mix.

Methods: Thin layers (~ 0.1mm) of commercial, dual-cured resin cements (RelyX™ Unicem 2 Automix Self-Adhesive Resin Cement and RelyX™ ARC Adhesive Resin Cement (3M ESPE); Panavia F 2.0 (Kuraray) were mixed according to manufacturer instructions and placed on the temperature-controlled surface of a horizontal diamond attenuated total reflectance accessory (Golden Gate, SPECAC, Cranston, RI), in a Fourier transform infrared spectrometer (FTS-40, Digilab/Biorad, Cambridge, MA) and allowed to self-cure at pre-determined temperatures (20°, 30°, 40°C). Spectra were obtained continuously at 5 second intervals for 1 hour at 2 cm-1 resolution. Conversion at 1 hour was determined by monitoring changes in absorbance ratios of peak heights (aliphatic C = C [1636 cm-1]/aromatic C = C [1608 cm-1]). Five replications were made for each test condition. Within a given resin cement, data were analyzed using a 1-way ANOVA and Tukey’s post-hoc test at 0.05 pre-set alpha.

Results: Table displays mean percent conversion (SD).

<table>
<thead>
<tr>
<th>Isothermal Temperature</th>
<th>RelyX Unicem 2</th>
<th>RelyX ARC</th>
<th>Panavia F2.0</th>
</tr>
</thead>
<tbody>
<tr>
<td>20°C</td>
<td>59.7 (0.7)a</td>
<td>33.3 (1.8)a</td>
<td>60.7 (1.7)a</td>
</tr>
<tr>
<td>30°C</td>
<td>66.6 (0.7)b</td>
<td>42.3 (2.6)b</td>
<td>60.9 (2.4)b</td>
</tr>
<tr>
<td>40°C</td>
<td>71.2 (0.6)c</td>
<td>49.8 (1.2)c</td>
<td>61.3 (2.2)c</td>
</tr>
</tbody>
</table>

Within a product (column) groups having similar letters were not significantly different. Conversion values are not compared among products. Conversion of two cements (RelyX Unicem 2 Automix Self-Adhesive Resin Cement and RelyX ARC Adhesive Resin Cement) were significantly affected by temperature: lower temperature resulted in lower conversion. One product (Panavia F 2.0) did not display a significant effect of temperature on conversion at 1 hour from mix.

Conclusions: Within the range of room temperature to physiologic temperature, there is a great variation in the extent of monomer conversion of dual-cure cements when polymerized in the self-cure mode, with some products being significantly affected and others not.

This abstract is based on research that was funded entirely or partially by an outside source: 3M ESPE

3M ESPE Summary

Aim of Study: To determine the effect of temperature on the conversion rate of 3 different cements.

Summary of Results: The self adhesive resin cement RelyX Unicem 2 Automix Self-Adhesive Resin Cement as well as RelyX ARC Adhesive Resin Cement showed a significant increase in conversion rate with rising temperature, while Panavia F 2.0 had stable conversion rates within the tested temperature range. These results underline that some cements are designed to work best at body temperature, so in vitro testing should be set up to take this into account in order to obtain relevant results.
RelyX™ Unicem 2 Automix Self-Adhesive Resin Cement/RelyX™ Fiber Post

Effect of Fiberpost Depth on Resin Cement Conversion

Friday, June 22, 2012: 3:45 p.m. – 5:00 p.m.
Location: Poster Hall (Convention Center)
Presentation Type: Poster Session
F. RUEGGEBERG, Dental Materials, Georgia Health Sciences University, Augusta, GA, C. AZEVEDO, Campinas State University, Piracicaba, Brazil and M.F. DE GOES, Restorative Dentistry, Piracicaba Dental School — University of Campinas, Piracicaba, SP, Brazil

Objectives: To determine the effect of fiberpost depth on monomer conversion of commercial resin cements.

Methods: Ten-mm long bovine incisor root sections were restored with fiber posts (#3, RelyX™ Fiber Post, 3M ESPE) and three commercial, dual-cure resin cements: RelyX™ Unicem 2 Automix Self-Adhesive Resin Cement or RelyX™ ARC Adhesive Resin Cement, 3M ESPE; Panavia F2.0, Kuraray. Five-mm of post remained coronal to the root. Restored roots were sectioned providing lengths of 2, 4, 6, 8 or 10mm. A small amount of each cement was mixed and immediately placed on a heated (35°C) horizontal attenuated-total-reflectance stage. Spacers provided uniform thickness (0.1mm). Mylar was placed to flatten paste and the infrared (IR) spectrum was obtained, after which a pre-sectioned root segment was placed over the Mylar. A light curing unit (Elipar™ S10 LED Curing Light, 3M ESPE) exposed the coronal fiberpost end using manufacturer-recommended time. After thirty minutes, another IR spectrum was obtained. Spectra (16 scans at 2 cm⁻¹) of resin films were obtained when directly light curing, or allowing total self-cure. Monomer conversion was determined using conventional methods comparing pre- and post-cure ratios of aliphatic and aromatic C = C absorbance heights. N = 5. Within a resin brand, results were subjected to 1-way ANOVA and the Tukey post-hoc test: pre-set alpha = 0.05.

Results: Table displays mean conversion (sd) at each depth and control.

<table>
<thead>
<tr>
<th>Resin Cement</th>
<th>Post Depth in Root (mm)</th>
<th>Controls</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td>RelyX ARC</td>
<td>78.1 (1.2)</td>
<td>76.6 (0.7)</td>
</tr>
<tr>
<td>RelyX Unicem 2</td>
<td>61.2 (0.6)</td>
<td>60.2 (0.4)</td>
</tr>
<tr>
<td>Panavia F2.0</td>
<td>65.5 (1.8)</td>
<td>65.0 (1.4)</td>
</tr>
<tr>
<td></td>
<td>Self-Cure</td>
<td>Light-Cure</td>
</tr>
<tr>
<td>RelyX ARC</td>
<td>66.5 (0.3)</td>
<td>77.7 (0.3)</td>
</tr>
<tr>
<td>RelyX Unicem 2</td>
<td>43.3 (3.3)</td>
<td>62.0 (0.5)</td>
</tr>
<tr>
<td>Panavia F2.0</td>
<td>61.5 (4.7)</td>
<td>66.2 (1.6)</td>
</tr>
</tbody>
</table>

Within each resin, ANOVA indicated significant influence of cure depth. Within a given product (row) groups having similar letters are not significantly different. All resins demonstrated significant influence of light curing, even up to 10mm post depth. Self-cure conversion of all resins was significantly lower than light-cure values, with Panavia F2.0 showing the least difference.

Conclusions: Conversion of all resin cements was significantly influenced by light transmission through up to 10mm post depth. In all instances, light-cure enhanced conversion over self-curing.

This abstract is based on research that was funded entirely or partially by an outside source: 3M ESPE

3M ESPE Summary

Aim of Study: To determine the effect of light transmission through a fiberpost at different depths of the root on the degree of conversion of 3 different dual-cure cements: RelyX Unicem 2 Automix Self-Adhesive Resin Cement, RelyX ARC Adhesive Resin Cement, Panavia F2.0.

Summary of Results: All cements showed a reduction of conversion rates with increasing depth of the fiberpost within the root. However overall light cure yielded higher conversion rates even at the lowest part of the root than the dark cure control: Conversion rates for all cements remained higher than 50% at the lowest part of the root tested.
Influence of Moisture on Dentin Adhesion Performance of Resin Cements

Objectives: The purpose of this in-vitro investigation was to compare shear bond strength (SBS) of different adhesive resin cements and their dedicated adhesives to bovine dentin under different moisture conditions.

Methods: Materials tested were Multilink® Automix/Multilink® Primer A/B (Ivoclar-Vivadent), Panavia™ F2.0/ED Primer II (Kuraray), NX3/Optibond® Solo™ plus (Kerr), NX3/Optibond® All-In-One (Kerr), RelyX™ Ultimate Adhesive Resin Cement/Scotchbond™ Universal Adhesive (3M ESPE).

Bovine teeth were ground flat to expose dentin, polished (grit 320 sandpaper), water-rinsed and divided in three groups. Group 1 was dried with air according to manufacturers’ instructions. Group 2 was left wet and group 3 was slightly overdried with air.

Dedicated adhesive systems were applied according to the manufacturers’ instructions. Stainless steel rods were cemented under pressure (20 g/mm²) onto the teeth and light cured. Specimens were stored for 24 hours at 36°C and 100% relative humidity. SBS was measured using a universal testing machine (Zwick Z010, crosshead speed: 0.75mm/minute). Data obtained were analyzed using Multiple Range Test (Fisher’s LSD; p < 0.05; n = 6).

Results: Statistical analysis revealed significant differences between the tested adhesive resin cements depending on tooth surface conditions (see table). Values with different superscript characters are statistically different.

<table>
<thead>
<tr>
<th>Material</th>
<th>SBS Group 1 [MPa]</th>
<th>SBS Group 2 [MPa]</th>
<th>SBS Group 3 [MPa]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Multilink Automix/Primer A&amp;B</td>
<td>13.9 ± 2.7c,d</td>
<td>11.7 ± 7.0c,d</td>
<td>15.6 ± 5.8c</td>
</tr>
<tr>
<td>Panavia F2.0/ED Primer II</td>
<td>26.8 ± 7.5b</td>
<td>16.4 ± 3.9b</td>
<td>24.4 ± 3.3b</td>
</tr>
<tr>
<td>NX3/Optibond All-In-One</td>
<td>14.7 ± 1.6c,d</td>
<td>10.1 ± 2.7c,d</td>
<td>15.9 ± 6.4c</td>
</tr>
<tr>
<td>NX3/Optibond Solo Plus/ Etch</td>
<td>8.2 ± 1.9d</td>
<td>16.5 ± 5.0d</td>
<td>30.6 ± 11.4d</td>
</tr>
<tr>
<td>RelyX Ultimate/Scotchbond Universal</td>
<td>38.6 ± 6.7a</td>
<td>41.9 ± 10.0a</td>
<td>39.9 ± 3.8a</td>
</tr>
</tbody>
</table>

Within a product (column) groups having similar letters were not significantly different. Conversion values are not compared among products. Conversion of two cements (RelyX™ Unicem 2 Automix Self-Adhesive Resin Cement and RelyX™ ARC Adhesive Resin Cement) were significantly affected by temperature: lower temperature resulted in lower conversion. One product (Panavia F2.0) did not display a significant effect of temperature on conversion at 1 hour from mix.

Conclusions: RelyX™ Ultimate Adhesive Resin Cement shows highest adhesion performance overall and independently of moisture conditions. Adhesion performance of most other cements strongly depends on moisture conditions.
RelyX™ Ultimate Adhesive Resin Cement (cont.)

3M ESPE Summary

Aim of Study: To determine shear bond strength of 5 adhesive resin systems to dentin under varying moisture conditions.

Summary of Results: Overall the new adhesive system of RelyX Ultimate Adhesive Resin Cement combined with Scotchbond Universal Adhesive obtained the highest as well as the most consistent bond strength values independent of whether the dentin was left slightly moist, wet or overdried. This should give the clinician more flexibility for good cementation performance independent of the level of moisture of the dentin and reduce the risk of overdrying for fear of creating post operative sensitivities.
Lava™ Zirconia

Fracture Strength of All-Ceramic Restorations After Fatigue Loading

B. BALADHANDAYUTHAM¹, P. BECK², M.S. LITAKER³, D. CAKIR² and J. BURGESS², ¹School of Dentistry, University of Alabama at Birmingham, Birmingham, AL, ²University of Alabama at Birmingham, Birmingham, AL, ³Dept. of General Dental Sciences, University of Alabama at Birmingham, Birmingham, AL

Objectives: To measure and compare fracture strength of monolithic and bilayered Lava and e.max crowns after load cycling.

Methods: To compare fracture strengths of bilayered and monolithic Lava Zirconia/3M ESPE and e.max lithium disilicate/Ivoclar Vivadent crowns prepared with varying manufacturing techniques and thicknesses (table). A full crown preparation was made on typodont mandibular first mandibular (Kilgore201), scanned/Lava™ Chairside Oral Scanner C.O.S./3M ESPE and sent to 3M ESPE to have Z100™ composite resin dies prepared. Crowns were fabricated with full contour Lava™ Design 5.0 Software. For Lava™ DVS system, DVS fusion porcelain was applied to the occlusal surface of the copings and fused by sintering. Veneering was done by experienced technicians for hand-veneered groups.

<table>
<thead>
<tr>
<th>Experimental Groups</th>
<th>Dimensions</th>
<th>Fracture strength(N) Mean ± SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lava-DVS</td>
<td>t = 1.2mm/(0.6mm zirconia core + 0.6mm DVS)</td>
<td>2624.76 ± 289.86</td>
</tr>
<tr>
<td>Lava-Hand veneered</td>
<td>t = 1.2mm/(0.6mm zirconia core + 0.6mm feldspathic porcelain hand layered)</td>
<td>2655.25 ± 590.04</td>
</tr>
<tr>
<td>Lava-Monolithic</td>
<td>t = 0.6mm/zirconia core)</td>
<td>1668.48 ± 311.06</td>
</tr>
<tr>
<td>IPS e. max CAD</td>
<td>t = 1.2mm/(monolithic lithium disilicate)</td>
<td>1465.20 ± 329.89</td>
</tr>
<tr>
<td></td>
<td>t = 1.5mm/monolithic lithium disilicate)</td>
<td>2026.83 ± 364.47</td>
</tr>
<tr>
<td></td>
<td>t = 1.5mm/ bilayered lithium disilicate core + feldspathic porcelain hand layered)</td>
<td>1731.90 ± 315.26</td>
</tr>
</tbody>
</table>

Crowns were cemented (RelyX™ Luting Plus RMGI Cement/3M ESPE), stored (37°C/24 hours), load cycled (200,000 cycles/25N/40 cycles/minute). At 50,000 cycles crowns were examined using digital microscope (Keyence VHX-600) at 40 and 100X for chipping/cracks/fracture by staining the crown surface with 10% methylene blue. At the end of 200,000 cycles they were loaded to failure (1mm/min) using a universal testing machine (Instron/Model 5565).

Results: Microscopic evaluation of the surface did not reveal cracks but minor wear facets were observed. Lava Zirconia bilayered groups showed two-step failure. Crowns from other groups fractured as single event (Keyence high speed camera).

Conclusions: Zirconia bilayered crowns showed the highest fracture loads, lithium disilicate monolithic crowns showed the lowest. Monolithic zirconia crowns of 0.6mm thickness resulted in relatively high magnitude fracture loads. Supported in part by a grant from 3M ESPE.

3M ESPE Summary

Aim of Study: To compare the fatigue resistance and fracture strength of monolithic and veneered Lava™ Frame Zirconia crowns as compared to monolithic and cut-back lithium disilicate crowns.

Summary of Results: Lava Zirconia veneered crowns showed the highest fracture loads, lithium disilicate monolithic crowns showed the lowest. Monolithic Lava All-Zirconia crowns of 0.6mm thickness showed higher fracture strength than lithium disilicate crowns of twice the thickness. Lava All-Zirconia crowns offer high strength even with conservative, tooth preserving preparation.
Lava™ Ultimate Restorative

Two-Body Wear Behavior of a New Resin Nanoceramic CAD/CAM Material

R.P. RUSIN1, V.A. RUSSELL1, S. VELAMAKANNI1, A.S. FOK2, M. PINTADO2, C.J. APARICIO2, R. DELONG2, W.H. DOUGLAS2 and A.B. SOARES1, 13M ESPE, St. Paul, MN, 2University of Minnesota, Minneapolis, MN

Objectives: Characterize the two-body wear of a new resin nanoceramic CAD/CAM material, 3M™ ESPE™ Lava™ Ultimate Restorative (LVU), compared with commercially available ceramic materials. LVU contains about 79 wt.% nanoceramic particles that reinforce a highly crosslinked polymeric matrix.

Methods: Two-body wear was assessed on polished material surfaces opposed by a human third molar palatal cusp, using computer-controlled motion that mimics natural chewing. The biomechanics were as previously reported: 15N peak load, occlusal contact 0.22–0.25 second, deionized water immersion, with slow occlusal energy input of 2 cycles/second for 300k cycles. The surface topography of the enamel and test material was profiled with a contact digitizer before and after chewing, allowing volume loss of material and enamel to be determined. Data were analyzed via ANOVA with Dunnett’s post-hoc test (p < 0.05), each group compared pairwise to LVU.

Results: Volume loss of material and enamel and pairwise statistical comparison to LVU are shown in the table.

<table>
<thead>
<tr>
<th>Material Code</th>
<th>n</th>
<th>Disk Volumetric Wear, mm³</th>
<th>SD</th>
<th>Comparison to LVU</th>
<th>Cusp Volumetric Wear mm³</th>
<th>SD</th>
<th>Comparison to LVU</th>
</tr>
</thead>
<tbody>
<tr>
<td>3M™ ESPE™ Lava™ Ultimate Restorative (A2-HT) LVU</td>
<td>8</td>
<td>0.100</td>
<td>0.040</td>
<td>—</td>
<td>0.005</td>
<td>0.004</td>
<td>—</td>
</tr>
<tr>
<td>Ivoclar™ IPS Empress™ CAD Block EMP</td>
<td>5</td>
<td>0.101</td>
<td>0.060</td>
<td>p &gt; 0.05</td>
<td>0.123</td>
<td>0.051</td>
<td>p &lt; 0.01</td>
</tr>
<tr>
<td>Vita™ Vitabloc™ Mark II Block VM2</td>
<td>7</td>
<td>0.047</td>
<td>0.027</td>
<td>p &lt; 0.05</td>
<td>0.050</td>
<td>0.021</td>
<td>p &lt; 0.05</td>
</tr>
<tr>
<td>Ivoclar™ IPS E.max™ CAD Block EMX</td>
<td>6</td>
<td>0.084</td>
<td>0.069</td>
<td>p &gt; 0.05</td>
<td>0.065</td>
<td>0.056</td>
<td>p &lt; 0.05</td>
</tr>
</tbody>
</table>

Conclusions: The wear of the new resin nanoceramic material LVU against enamel is statistically not different from that of EMP or EMX and statistically greater than VM2. The volumetric wear of enamel opposing LVU material is statistically significantly lower that opposing EMP, VM2 and EMX.

This study was supported in part by MDRCBB and 3M Company.

This abstract is based on research that was funded entirely or partially by an outside source: This study was supported in part by MDRCBB and 3M Company.

3M ESPE Summary

Aim of Study: Compare two-body wear behavior of a new resin nanoceramic CAD/CAM material, 3M ESPE Lava Ultimate Restorative, with commercially available ceramic materials.

Summary of Results: The wear of the new resin nanoceramic material Lava Ultimate against enamel is statistically not different from that of EMP or EMX and statistically greater than VM2. The volumetric wear of enamel opposing LVU material is statistically significantly lower that opposing EMP, VM2 and EMX.
Lava™ Frame Zirconia

4–8 Years Retrospective Dental Laboratory Survey of Zirconia-Based Restorations

A. RAIGRODSKI, University of Washington, Seattle, WA; S. DOGAN, Restorative Dentistry, University of Washington, Seattle, WA; and G. ENGLUND, Issaquah Dental Lab, Issaquah, WA

Objectives: To survey frequency of remakes of zirconia-based restorations in a dental laboratory at 4–8 years after delivery.

Methods: Data was collected on crowns and fixed partial dentures (FPDs) in which zirconia copings/frameworks were milled (3M™ ESPE™ Lava™) and layered with veneering porcelain all in one dental laboratory. Cantilever FPDs, splinted crowns, implant-supported restorations and restorations delivered less than 4 years prior to survey were excluded. Data included tooth numbers, time from delivery, brand of veneering porcelain and requests for remakes. Probability distributions of remakes were reported. Chi-square test was used for inter-group comparisons (P < 0.05).

Results: 24392 zirconia-based crowns (21220 (87%) posterior and 3172 (13%) anterior) were delivered. 605 were layered with Lava™ Ceram and 23787 were layered with Noritake CZR. Requests for remake were made for 185 (0.75%) of 24392 zirconia-based crowns. 72 out of 185 crowns were sent for remake prior to cementation (posterior 67 (0.2%) and anterior 5 (0.02%)). Other remakes of crowns were requested after cementation within a timeframe ranging from 1 to 33 months of service (posterior 97 (0.3%) and anterior 16 (0.06%). Total number of remakes was 164 (0.67%) for posterior and 21 (0.08%) for anterior crowns (p = 0.57). Remakes were 44 (0.18%) for premolars and 120 (0.49%) for molars (p = 0.05). Comparisons were statistically not significant. 1,482 zirconia-based FPDs with 580 posterior, 578 anterior and 324 mixed with both posterior and anterior abutments (n = 324) were also surveyed. There were only 4 (0.2%) remakes. 2 posterior restorations were resent for remake before cementation. 2 remakes of anterior restorations were requested within a time frame of 3 and 26 months after cementation.

Conclusions: Within limitations of this retrospective survey it may be concluded that frequency of remakes of zirconia-based restorations after 4–8 years of service made by one dental laboratory was low for crowns and FPDs.

3M ESPE Summary

Aim of Study: To determine the remake rate of porcelain veneered Lava Zirconia crowns and bridges by means of a retrospective lab survey.

Summary of Results: 25874 porcelain veneered Lava Zirconia restorations showed low remake rates between 0.08% and 0.67% after 4–8 years of service.
Lava™ Frame Zirconia

Bond Strength of Porcelain to Y-TZP with Various Thicknesses

A. ARREJAI1; R. GIORDANO2; and R. POBER2, 1University of Dammam, Riyadh, Saudi Arabia, 2Goldman School of Graduate Dentistry, Boston University, Boston, MA

Objectives: Evaluate the effect of various Y-TZF thicknesses on its bond strength to conventional veneering porcelain.

Methods: Lava™ (3M ESPE) was used as Y-TZF material. VITA VM®9 (Vita-Zahnfabrik) was used as the veneering porcelains. Lava were sectioned into 30 discs with thicknesses of: 1mm, 2mm and 5mm respectively. The powder water slurry mix was condensed into a mold to form a button with a diameter of 4mm and height of 3mm. Specimens were subjected to a shear bond test using a 4mm notched blade on universal testing machine (Instron) with a crosshead speed of 0.5mm/min. Statistical analysis was done using ANOVA and Tukey post hoc test at p = 0.05.

Results: Shear bond strength of VITA VM®9 to Lava with a thickness of 1mm is 63 ± 3.3 MPa, 2mm is 33.1 ± 5.3 and Lava with thickness of 5mm is 29.2 ± 2.2 MPa.

Conclusions: The thickness of Lava core materials has a significant effect on its bond strength to VITA VM®9.

Keywords: Adhesion, CAD/CAM, Ceramics, Dental materials and Prosthodontics

3M ESPE Summary

Aim of Study: To investigate the shear bond strength of VITA VM®9 porcelain to Lava Frame Zirconia disks of various thicknesses.

Summary of Results: VITA VM®9 porcelain showed high shear bond strength of approximately 30 to 60 MPa to Lava Frame Zirconia. In the disk configuration the shear bond strength was found to decrease by a factor of approximately two when the zirconia thickness was increased by a factor of two or five, respectively.
**Lava™ Frame Zirconia**

**Effect of Air-Abrasion Particle-Size on Flexural Strength/Phase Transformation of Zirconia**

F.O. ABI-RACHED¹, R.G. FONSECA¹, J.M.S.N. REIS¹, P. BALDISSARA² and G.L. ADABO¹, ¹Department of Dental Materials and Prosthodontics, Araraquara Dental School, Univ Estadual Paulista – UNESP, Araraquara — São Paulo, Brazil, ²Department of Prosthodontics, University of Bologna, Bologna, Italy

**Objectives:** This study evaluated the effect of the particle size used for air-abrasion on the flexural strength and phase transformation of a commercially available zirconia (Y-TZP).

**Methods:** For both flexural strength (20.0 x 4.0 x 1.2mm) and phase transformation (14.0mm diameter x 1.3mm thickness) evaluation, zirconia specimens were made from Lava™ (3M ESPE) and their surfaces were treated as follows: 1) as-sintered (control); 2) 50μm Al₂O₃ particles; 3) 120μm Al₂O₃ particles; 4) 250μm Al₂O₃ particles; 5) 30μm silica-modified Al₂O₃ particles (Cojet™ Sand – 3M ESPE); 6) 120μm Al₂O₃ particles followed by 110μm silica-modified Al₂O₃ particles (Rocatec™ Plus – 3M ESPE) and 7) 110μm silica-modified Al₂O₃ particles (Rocatec Plus). Three-point flexural strength test was conducted in a mechanical testing machine (EMIC DL2000). Phase transformation (%) was assessed by X-ray diffraction (XRD) analyses. Data were analyzed by 1-way ANOVA and Tukey HSD post hoc test (α = .05).

**Results:** Except for Cojet™ Sand group, which exhibited statistically similar flexural strength to that of the as-sintered group and for the group abraded with 250μm Al₂O₃ particles, which presented the lowest strength, air-abrasion with the other particle sizes provided the highest values, with no significant difference among them. The as-sintered specimens presented no monoclinic phase while the other groups exhibited a relative amount of monoclinic phase that varied from 3 to 9%. The groups abraded with smaller particles exhibited lower percentages of monoclinic phase.

**Conclusions:** Flexural strength of zirconia was affected, positively or negatively, by the particle size, except for air-abrasion with Cojet Sand. Air-abrasion promoted phase transformation (tetragonal to monoclinic) in all groups and the percentage of monoclinic phase varied according to the particle size.

**3M ESPE Summary**

**Aim of Study:** To investigate the influence of sandblasting on the strength of Lava Frame Zirconia.

**Summary of Results:** Strength of Lava Frame Zirconia is maintained or increased by small particle air abrasion e.g. with 30μm Cojet Sand or 50μm alumina oxide. Large particle air abrasion (250μm alumina oxide) deteriorates strength and has to be avoided.
Fracture Resistance of Restorative Materials Subjected to Cumulative Impact Load

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Objectives: The aim of this study was to compare the fracture resistance of indirect restorative materials under repeated impact loads with increasing magnitude.

Methods: Disc specimens of 12mm diameter and 4mm thick were prepared using Lava Ultimate Restorative (LVU: 3M ESPE), IPS Empress™ CAD Block (EMP: Ivoclar™ Vivadent™) and IPS e.max™ CAD (EMX: Ivoclar™ Vivadent™). The sample size per group was n = 10. A 12g, 28.5mm-diameter steel ball was repeatedly dropped onto each disc from increasing heights (0.05m, 0.08m, 0.13m, 0.25m, 0.48m to 0.61m) until the disc fractured. The cumulative energy required to fracture the disc was calculated as the sum of the impact energy values from each ball drop until fracture, inclusive. The discs were visually inspected for damage using transillumination.

Results: LVU had the highest impact fracture resistance; followed by EMX and then EMP. The mean cumulative energy required to fracture the disc specimens of the 3 groups were 1004.53, 653.9 and 106.6 mJ, with a standard deviation of 381.6, 232.5, 75.9 mJ respectively. Differences between the 3 groups were statistically significant (Mann-Whitney U test, p < 0.05). Furthermore, EMP and LVU showed fewer cases of complete fracture, as seen in most of the EMX specimens.

Conclusions: The cumulative impact load test could provide quantitative comparison between the fracture resistances of dental restorative materials under repeated impact loading.

3M ESPE Summary

Aim of Study: Compare the fracture resistance of indirect restorative materials under repeated impact loads with increasing magnitude.

Summary of Results: Lava Ultimate Restorative displayed statistically significantly greater cumulative impact fracture resistance than the lithium disilicate and feldspathic glass ceramic materials. The cumulative impact load test could provide quantitative comparison of the fracture resistance of dental restorative materials under repeated impact loading.
Objectives: The objective of this prospective, randomized, controlled clinical study was to evaluate the clinical performance of zircon-based cantilever fixed dental prostheses (FDPs).

Methods: The investigation was realized by twenty-one cantilever FDPs supplying 21 patients. The FDPs were designed as three or four units replacing one premolar or one incisor. Patients with missing canines were not included. These 21 FPDs were randomly assigned to 11 zirconia cantilever FDPs (test group) and 10 conventional metal-ceramic cantilever FDPs (control group). The all-ceramic FDPs were manufactured using a Y-TZP framework (Lava™, 3M ESPE) and veneered with feldspatic ceramic (Lava™ Ceram, 3M ESPE). The 10 metal-ceramic FDPs were manufactured by fusing a conventional feldspathic ceramic to a noble metal alloy. Controls were scheduled after 2 weeks (baseline), 6 months, 1 year and after 2 years. Complications, plaque accumulation, signs of inflammation of the gingiva, aesthetic performance and patients satisfaction were documented. Statistical analysis was performed by use of the Log-rank-test, the Mann-Whitney U-test and the Chi-square test.

Results: During the two-years observation period, a total of four clinical relevant complications occurred, including root canal treatment once in each group and two chippings in the test group. The Log-rank-test showed no significantly difference to the rate of complication (p = 0.315). After 2 years in service all restorations showed similar plaque retention and bleeding indices of the marginal gingiva. Without significant differences between the groups. All patients rated the aesthetic performance of both types of FDPs very good without significant differences between the test- and the control-group (p ≥ 0.173). No caries, discolorations, retention loss was observed.

Conclusions: Stability and aesthetic performance were acceptable for all-ceramic cantilever FDPs made of zirconia. A long observation period with a large number of all-ceramics FDPs is needed to make valid predictions about the longevity of these restorations.

3M ESPE Summary

Aim of Study: To investigate the clinical performance of Lava Frame Zirconia cantilever bridges compared to conventional PFM cantilever bridges.

Summary of Results: After 2 years the pilot study revealed acceptable clinical performance for Lava Frame cantilever bridges with no framework failures.
Influence of the Zirconia Core-Design on the In-Vitro Failure Performance

C. LETSCH¹, M. BEHR¹, C. KOLBECK², G. HANDEL¹ and M. ROSENTRITT¹, ¹Department of Prosthetic Dentistry, Regensburg University Medical Center, Regensburg, Germany, ²Dept. of Prosthetic Dentistry, Regensburg University Medical Center, Regensburg, Germany

Objectives: The aim of this study was to test whether the core design of ceramic molar crowns has a significant influence on chipping of ceramic veneering during chewing simulation. The aim was to compare layered- and pressed- veneering techniques.

Methods: The roots of PMMA molars (tooth 46, 1mm deep circular shoulder, Morita) were coated with a polyether layer (1mm, Impregum™, 3M ESPE) for simulating the periodontial mobility and arranged in resin (Palapress Vario, Heraeus-Kulzer). Molar copings (n = 8 per series) of zirconia (3M ESPE Lava™ Ceram) were made and veneered with layering ceramic veneering (“LC” — Lava Ceram, 3M ESPE) or press ceramic (“ZP” — ZirPress, Ivoclar-Vivadent, FL). The veneering thickness varied between 0.6mm (anatomically reduced) and 1.5mm (simple core) according to the design. For investigating the influence of the cooling regime, one group (“LCsc”) was repeated with reduced cooling rate. All crowns were cemented using RelyX™ Unicem Cement (3M ESPE). Identical antagonists (CoCr-alloy; Wirobond LFC, Bego/ Vita VMK13, Vita) and crowns were transferred to thermal cycling and mechanical loading [TCML] with 1,200,000 [ML]/50N and 6000 [TC]/2 minutes each cycle — water: 5°C and 55°C), which is supposed to simulate five years of service. During simulation the restorations were controlled (chipping, fracture, etc.) every 100,000 ML. Type and size of crown failure was analyzed (SEM; Quanta; FEI-Philips, NL). Statistics: One-way ANOVA (= 0.05).

Results: With pressed veneering for both core designs, no failures could be found during chewing simulation. For the layering technique two failures were detected for the simple core design and no failure for the anatomically reduced design. Slow cooling during veneering reduced failures for the layering technique with simple core design.

Conclusions: The results showed that cracking and chipping were dependent on the design of the core and the type of veneering. Slow cooling during fabrication reduced failure sensitivity.

3M ESPE Summary

Aim of Study: To investigate the influence of core design on the chipping behavior of veneered Lava Frame Zirconia crowns.

Summary of Results: Anatomic core design with optimized porcelain support was found superior in terms of in-vitro chipping resistance as compared to a simple core design.
Lava™ Frame Zirconia

Behavior of Porcelain-Veneered Zirconium Oxide Restorations After Static Load

Friday, September 2, 2011: 8:00 a.m. – 5:30 p.m.
Location: Poster Hall (Theoretical Building of the Semmelweis University)
Presentation Type: Poster Session
R. AGUSTÍN PANADERO SR., A. FONS FONT, J.L. ROMÁN RODRÍGUEZ, M. GRANELL RUÍZ, C. LABAIG RUEDA and M.F. SOLÁ RUÍZ, Department of Buccofacial Prosthetics, Faculty of Medicine and Dentistry, University of Valencia. Spain, Valencia, Spain

Objectives: To study the behavior of three types of porcelain-veneered crowns with zirconia cores when subjected to static compressive loading.

Methods: 80 individual full coverage crowns were studied. Crowns were divided in to four groups: Group I: Ivoclar IPS e.max Zir-CAD crowns (Core: IPS e.max ZirCAD; Porcelain Veneer: IPS e.max Ceram); Group II: Ivoclar IPS e.max ZirPress crowns (Core: IPS e.max ZirCAD; Porcelain Veneer: IPS e.max ZirPress); Group III: 3M ESPE Lava™ Crowns (Core: Lava™ Frame Zirconia; Porcelain Veneer: Lava™ Ceram); Group IV (Control Group): metal-ceramic crowns with porcelain stratification layering technique (Core: Rexillium V nickel chrome alloy; Porcelain Veneer: IPS d.SIGN ceramic). The compression test was carried out using an Instron 4202 testing machine. The load applicator descended onto the sample exercising continuous vertical force with a crosshead speed of 0.5mm per second, moving vertically downwards perpendicular to the occlusal zone.

Results: In the porcelain veneer compressive test, Group IV, the control group, achieved the highest values (2310.49 N), closely followed by Group III (2210.95 N). Group II (1818.01 N) and Group I (1773.92 N) came in third and fourth place respectively. The different groups were compared to the control group applying Mann-Whitney non-parametric tests (ZirPress vs Control, p-value: 0.000; ZirCAD vs Control, p-value: 0.000; Lava vs. Control, p-value: 0.565), taking a significance level of 5% (p-value = 0.05). When the resistance of different porcelains is compared, excepting the control group (Lava vs. ZirPress, p-value: 0.002; Lava vs. ZirCAD, p-value: 0.001; ZirPress vs. ZirCAD, p-value: 0.553).

Conclusions: Resistance to compressive loading for the metal-ceramic and Lava samples obtained an average surface fracture value that was significantly greater in comparison with the ceramic coatings of ZirCAD and Zir-Press. All the porcelain veneers analyzed far surpassed average compression loads subjected during mastication as established by ISO 6872.

3M ESPE Summary

Aim of Study: To compare the fracture strength of veneered zirconia crowns to a PFM control.

Summary of Results: Lava Zirconia crowns achieved fracture values equivalent to PFM and higher than the IPS e.max ZirCAD crowns investigated.
Lava™ Frame Zirconia

Influence of Surface Treatment on Wear of Solid Zirconia

Friday, September 2, 2011: 8:00 a.m. – 5:30 p.m.
Location: Poster Hall (Theoretical Building of the Semmelweis University)
Presentation Type: Poster Session
L. KONTOS, C. SCHILLE and J. GEIS-GERSTORFER, Medical Materials and Technologies, University of Tubingen, Tuebingen, Germany
Influence of Surface Treatment on Wear of Solid Zirconia
Kontos L, Schille C, Geis-Gerstorfer J
University of Tuebingen, Sektion Medical Materials and Technology, Germany

Objectives: Recently there is a talk of the use of full-contour solid zirconia crown or bridge restorations with no porcelain overlay. That could be a useful solution by patients with bruxism or limited interocclusal space. However the hardness of zirconia could affect the opposite natural dentition. The aim of this in-vitro study was to investigate the role of surface treatments and glazing on wear of a zirconia material and its antagonist.

Methods: Fourty (40) plates 10 x 10 x 1mm made of Zirconia (Lava, 3M ESPE), divided in four equal groups, were sandblasted and ground under standardized conditions with a fine-grit diamond bur (Komet Brasseler, Germany) to simulate clinical conditions.

The group (a) was only sandblasted, (b) only ground, (c) was ground and additionally polished (EVE Ceramic Polishing-Set, Pforzheim) and (d) was ground and glazed. Wear behavior was measured with a pin-on-disk apparatus ABREX against 6mm Steatite balls as antagonists (45°, 5N load, 5000 cycles, water). The amount of wear was determined topographically using a 3-D profilometer (Concept 3D, Mahr, Germany) by measuring the height loss of the antagonist and the depth of wear Pt of the zirconia.

Results:

<table>
<thead>
<tr>
<th>Surface Condition</th>
<th>Surface Roughness [µm]</th>
<th>Depth of Wear [µm]</th>
<th>Height Loss of Antagonist [µm]</th>
</tr>
</thead>
<tbody>
<tr>
<td>A Sandblasted</td>
<td>0.44 ± 0.23</td>
<td>—</td>
<td>81 ± 23</td>
</tr>
<tr>
<td>B Ground</td>
<td>0.3 ± 0.09</td>
<td>—</td>
<td>84 ± 41</td>
</tr>
<tr>
<td>C Polished</td>
<td>0.23 ± 0.11</td>
<td>—</td>
<td>66 ± 23</td>
</tr>
<tr>
<td>D Glazed</td>
<td>0.32 ± 0.12</td>
<td>46.1 ± 22</td>
<td>85 ± 33</td>
</tr>
</tbody>
</table>

Work and Fmax were evaluated by linear regression for their correlation with instrument stringiness rating at either condition. Work correlated best with stringiness, $R^2 = 71\%$ for 1 second and 8mm/second and $R^2 = 73\%$ for 20 seconds and 1mm/second.

Conclusions: In the groups (a), (b) and (c) wear value Pt could not be determined (<1µm). Wear values of the antagonists (steatite balls) revealed a similar outcome in contact with (a), (b) and (d) in the range of 81 to 85µm, whereas (d) was more abrasive but not significantly. This can be attributed to the higher roughness of the glazed surface. A noticeable difference in the wear of the antagonist showed group (c) with the smallest value.

Keywords: Ceramics, Surfaces and Wear

continued on next page >
Lava™ Frame Zirconia (cont.)

3M ESPE Summary

Aim of Study: To compare the wear properties of roughened Lava Zirconia with a glazed surface.

Summary of Results: In the in vitro test used, roughened Lava Zirconia showed antagonist wear similar to state-of-the-art glaze material. No material wear was detected on Lava™ Zirconia in contrast to the glaze layer that showed significant wear.
Fracture Toughness of Zirconia Depending on Thermal and Hydrothermal Treatment

Friday, September 2, 2011: 8:00 a.m. – 5:30 p.m.
Location: Poster Hall (Theoretical Building of the Semmelweis University)
Presentation Type: Poster Session
B. THEELKE, R. DITTMANN and A. SCHMALZL, R&D Digital Oral Care, 3M ESPE, Seefeld, Germany

Objectives: Fracture Toughness describes the resistance of ceramics against crack propagation. Transformation toughened ceramics like Yttria stabilized Zirconia show different fracture toughnesses due to different crystal phase contents or test methods. Aim of this study is the investigation of fracture toughness depending on the test method and thermal or hydrothermal treatment.

Methods: Lava Zirconia (3M ESPE) specimens were sintered at 1500°C for 2 hours and ground to 30 bars of 4 x 3 x 40mm dimension. 15 samples were mechanically notched according to EN-ISO-6872 (SEVNB). To provoke smaller intergranular cracks for Single Crack in Flexure-Method (SCF) a Vickers Diamond pyramid was indented 15 seconds with 511N in remaining 15 bars. For both methods the bars were divided in three groups: untreated reference; tempered for 1350°C/0.5 hours and tempered with following hydrothermally aging for 30 hours. All bars were tested in 4-point-bending setup (Instron 5566). The crack length was measured by Laser Scanning Microscope (KeyenceVK-9710). The fracture toughness was calculated according to following equation $K_{1c} = \frac{Y}{\sigma \sqrt{a}}$. The crystal phase content was measured by XRD (BruckerD8 Discover, Monocapillar 200μm) at the crack area, caused by diamond saw and razor blade or Vickers indentation after testing.

Results: See Table 1

<table>
<thead>
<tr>
<th>Setup</th>
<th>Treatment</th>
<th>$K_{1c}$ [MPa√m]</th>
<th>p-value to $K_{1c}$ initial</th>
<th>av. monoclinic content [wt.%]</th>
<th>av. tetragonal phase content [wt. 5]</th>
<th>av. cubic and cubic2 phase content [wt.%]</th>
</tr>
</thead>
<tbody>
<tr>
<td>SEVNB</td>
<td>initial</td>
<td>7.31 +/- 1.71</td>
<td>—</td>
<td>9</td>
<td>57</td>
<td>34</td>
</tr>
<tr>
<td></td>
<td>tempered</td>
<td>3.45 +/- 0.15</td>
<td>0.007</td>
<td>0</td>
<td>100</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>tempered and hydrothermally aged</td>
<td>4.74 +/- 0.35</td>
<td>0.03</td>
<td>34</td>
<td>66</td>
<td>0</td>
</tr>
<tr>
<td>SCF</td>
<td>initial</td>
<td>4.75 +/- 0.32</td>
<td>—</td>
<td>13</td>
<td>87</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>tempered</td>
<td>5.73 +/- 0.19</td>
<td>&lt; 0.005</td>
<td>9</td>
<td>91</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>tempered and hydrothermally aged</td>
<td>7.82 +/- 0.14</td>
<td>&lt; 0.005</td>
<td>35</td>
<td>65</td>
<td>0</td>
</tr>
</tbody>
</table>

Presenting author’s disclosure statement: Employee of 3M ESPE

Conclusions: Tempering reduces the fracture toughness and the monoclinic phase content significantly for SEVNB tested samples. Tempering of SCF samples increases fracture toughness and decreases monoclinic phase content. Long term hydrothermally aging increases the fracture toughness by ≥ 30% and the monoclinic phase content for both methods compared to the tempered samples. A possible mechanism is the formation of pressure stress zones at the crack tip caused by phase transformation from tetragonal to monoclinic (local volume expansion) due to hydrothermal aging or mechanical preparation (SEVNB notching).
3M ESPE Summary

Aim of Study: To investigate how the fracture toughness of Lava Frame Zirconia depends on the test method and the thermal or hydrothermal treatment.

Summary of Results: The study lays out that phase transformation induced by mechanical preparation (i.e. notching for SEVNB), hydrothermal aging or tempering does influence the fracture toughness measurement results. Independent of the method fracture toughness value of Lava Zirconia was increased by hydrothermal aging.
Lava™ Frame Zirconia

Wear Behavior of Zirconia After Hydrothermal Accelerated Aging

R. DITTMANN, M. URBAN, P. BRAUN, A. SCHMALZL and B. THEELKE, R&D Digital Oral Care, 3M ESPE, Seefeld, Germany

Objectives: Investigation of zirconia wear behavior after hydrothermal accelerated aging.

Methods: Steatite spheres were used as antagonists (Ceramtec, Ø 6mm). 3M ESPE Lava Frame Zirconia (LFZ), Wieland Zenotec Zr Bridge translucent (WZZ) and 3M ESPE experimental veneering material (VM) were used as initial material groups (n = 4). All sample surfaces were polished with 9μm diamond suspension prior to testing. Groups (n = 4) of LFZ and WZZ were hydrothermally aged in a steam autoclave at 135°C, 2 bar for 5 hours and 30 hours respectively. Spheres and samples were fixed in a longitudinal moving abrasion test device (Elcometer 1720). Spheres were slid under water across material plates at a constant load of 5 N (path length 32mm, 37 cycles/minutes for 120 minutes). X-ray measurements were performed by micro diffraction (diameter 200μm) in Bragg-Brentano geometry (Bruker D8 Discover) and semi-quantitative phase analysis of monoclinic phase (M) was done by the Rietveld method (Bruker TOPAS software). Waviness depth (Wd) after abrasion was determined by profilometry (Mahr S2) at 6 positions per sample and surface roughness was measured before (Ra0) and after abrasion (Ra1). Sphere abrasion was measured by microscopy (Zeiss SV11) and volume loss (Vl) was calculated.

Results: Mean values for Vl, Wd, Ra0, Ra1 and M are summarized in Table 1. For Vl two sample t-tests (p < 0.05) were performed between each group.

Conclusions: The VM has shown a statistically significant higher antagonist wear compared to all zirconia groups before and after aging. For LFZ 30 hours hydrothermal accelerated aging induced 12 wt.% monoclinic crystal phase at the outer sample surface, however wear properties did not show a significant change. WZZ had 64 wt.% monoclinic phase after 30 hours aging and antagonist wear was statistically significant higher compared to the initial value.

<table>
<thead>
<tr>
<th></th>
<th>VM</th>
<th>LFZ</th>
<th>LFZ 5 hours aged</th>
<th>LFZ 30 hours aged</th>
<th>WZZ</th>
<th>WZZ 5 hours aged</th>
<th>WZZ 30 hours aged</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vl [mm³]</td>
<td>0.18</td>
<td>0.02</td>
<td>0.02</td>
<td>0.02</td>
<td>0.05</td>
<td>0.07</td>
<td></td>
</tr>
<tr>
<td>Wd [μm]</td>
<td>15.94</td>
<td>0.07</td>
<td>0.08</td>
<td>0.1</td>
<td>0.13</td>
<td>0.35</td>
<td></td>
</tr>
<tr>
<td>Ra0 [μm]</td>
<td>0.09</td>
<td>0.01</td>
<td>0.01</td>
<td>0.01</td>
<td>0.01</td>
<td>0.01</td>
<td></td>
</tr>
<tr>
<td>Ra1 [μm]</td>
<td>0.17</td>
<td>0.01</td>
<td>0.01</td>
<td>0.01</td>
<td>0.01</td>
<td>0.01</td>
<td></td>
</tr>
<tr>
<td>M [wt.%]</td>
<td>—</td>
<td>0</td>
<td>2</td>
<td>12</td>
<td>6</td>
<td>64</td>
<td></td>
</tr>
</tbody>
</table>

Presenting author’s disclosure statement: Employee of 3M ESPE

3M ESPE Summary

Aim of Study: To investigate the in vitro wear properties of Lava Frame and Zenotec zirconia materials before and after hydrothermal aging in comparison to a state-of-the-art veneering porcelain.

Summary of Results: Both Zirconia materials investigated were found more antagonist friendly than the veneering porcelain. Wear properties of Lava Frame Zirconia were stable with respect to aging. Wear properties of the Zenotec Zr Bridge translucent material were significantly affected by aging.
Wear of Enamel Opposing Aged Zirconia

S. JANYAVULA, N. LAWSON, D. CAKIR, P. BECK, L. RAMP and J. BURGESS, University of Alabama at Birmingham, Birmingham, AL

Aging dental zirconia roughens its surface due to transformation from the tetragonal to the monoclinic state.

Objectives: The effects of age-related roughening of zirconia on the wear of tooth enamel was measured.

Methods: Specimens (n = 8) were prepared by the manufacturer (3M ESPE) and divided into three groups: polished zirconia (Lava), aged zirconia (Lava) and a veneering porcelain (Lava™ Ceram). Accelerated aging of zirconia was accomplished by autoclaving the zirconia specimens for 5 hours at 135°C and 2 bar pressure. Human incisor enamel to enamel wear (n = 8) served as the control. Wear testing was conducted in a modified Alabama wear testing device. A load of 10N was applied at a frequency of 0.33Hz. 35% glycerine lubricant continuously flowed over the specimens. Human molar cusps were shaped into cones with a diamond bur. The bur preserved the enamel at the cusp tip and the cusps were used as antagonists in the wear device. Enamel cusps were duplicated and scanned by light profilometry at baseline and after 100,000 and 200,000 cycles of wear testing. Post-test scans were superimposed over baseline scans with ProScan software to calculate volumetric wear. Roughness of the ceramic specimens was measured before wear testing. Wear volumes and roughness values were analyzed with a one-way ANOVA and Tukey’s post-hoc analysis (alpha = 0.05).

Results:

<table>
<thead>
<tr>
<th></th>
<th>Volumetric enamel wear (mm³)</th>
<th>Roughness (Ra)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>100,000 cycles</td>
<td>200,000 cycles</td>
</tr>
<tr>
<td>Polished zirconia</td>
<td>0.099 ± 0.027a</td>
<td>0.177 ± 0.049a</td>
</tr>
<tr>
<td>Aged zirconia</td>
<td>0.139 ± 0.023a</td>
<td>0.202 ± 0.032a</td>
</tr>
<tr>
<td>Veneering porcelain</td>
<td>0.359 ± 0.053a</td>
<td>0.512 ± 0.051a</td>
</tr>
<tr>
<td>Enamel</td>
<td>0.237 ± 0.045a</td>
<td>0.358 ± 0.075a</td>
</tr>
</tbody>
</table>

Similar superscripts represent statistically similar groups.

Conclusions: Enamel wear against aged zirconia had similar roughness and produced similar wear of opposing enamel as polished zirconia. Both zirconia groups produced less enamel wear than the veneering porcelain or natural enamel.

Materials from 3M ESPE Supported by T32DE017607

This abstract is based on research that was funded entirely or partially by an outside source: NIDCR-T32DE017607

3M ESPE Summary

Aim of Study: To investigate the in vitro wear properties of Lava Frame Zirconia before and after hydrothermal aging in comparison to a state-of-the-art veneering porcelain and enamel.

Summary of Results: Lava Frame Zirconia was found more human enamel antagonist friendly than the veneering porcelain and enamel itself. Aging did not affect the wear properties of Lava Frame Zirconia.
Objectives: Determine the polish after toothbrushing abrasion of a new resin nanoceramic CAD/CAM material, 3M™ ESPE™ Lava™ Ultimate Restorative (LVU), compared with commercially available indirect and direct materials. LVU contains about 79 wt% nanoceramic particles that reinforce a highly crosslinked polymeric matrix.

Methods: Plates of each material (n = 5) were initially polished to a high gloss then subjected to toothbrushing abrasion with a popular over-the-counter dentifrice under a 450g load at 180–200 strokes/minute for 6000 cycles. Gloss (60° geometry) was measured using a Novo-Curve Glossmeter (Rhopoint Instruments).

Results: Mean gloss and standard deviation after 6000 cycles of toothbrushing are shown in the table. Letters in the column “SND” denote groups that are statistically not different after 6000 cycles of toothbrushing via ANOVA with Tukey’s t-test (p < 0.05).

<table>
<thead>
<tr>
<th>Material</th>
<th>Code</th>
<th>Mfr.</th>
<th>Gloss (SD) @ 6000 cycles</th>
<th>SND gloss @ 6000 cycles</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lava™ Ultimate Restorative</td>
<td>LVU</td>
<td>3M ESPE</td>
<td>85.6 (2.3)</td>
<td>A</td>
</tr>
<tr>
<td>IPS e.max® CAD</td>
<td>e.max</td>
<td>Ivoclar</td>
<td>87.3 (6.5)</td>
<td>A</td>
</tr>
<tr>
<td>IPS Empress® CAD</td>
<td>EMP</td>
<td>Ivoclar</td>
<td>89.7 (0.4)</td>
<td>A</td>
</tr>
<tr>
<td>VITABLOCS® Mark II Block</td>
<td>VM2</td>
<td>Vita</td>
<td>81.5 (2.4)</td>
<td>A</td>
</tr>
<tr>
<td>GC Initial™ MC Porcelain</td>
<td>IMC</td>
<td>GC</td>
<td>81.9 (1.2)</td>
<td>A</td>
</tr>
<tr>
<td>Paradigm™ MZ100 Block</td>
<td>MZ</td>
<td>3M ESPE</td>
<td>52.7 (16.2)</td>
<td>B</td>
</tr>
<tr>
<td>Esthet-X® Micro Matrix Restorative</td>
<td>ESX</td>
<td>Dentsply</td>
<td>42.2 (11.4)</td>
<td>B</td>
</tr>
<tr>
<td>Tetric EvoCeram® Filling Material</td>
<td>TEC</td>
<td>Ivoclar</td>
<td>23.6 (3.3)</td>
<td>C</td>
</tr>
</tbody>
</table>

Conclusions: The gloss of LVU after toothbrushing was statistically not different from that of glass ceramic materials e.max, EMP, VM2 and porcelain IMC and was statistically greater than that of composite materials MZ, ESX and TEC. These results show that the nanoceramic filler technology in LVU allows the material to retain its polish similar to glass ceramics and superior to direct composites.

Presenting author’s disclosure statement: Presenter is an employee of 3M ESPE

3M ESPE Summary

Aim of Study: Compare the polish after toothbrushing abrasion of a new resin nanoceramic CAD/CAM material, 3M ESPE Lava Ultimate Restorative, with commercially available indirect and direct materials.

Summary of Results: The gloss of Lava Ultimate Restorative after toothbrushing was statistically not different from that of lithium disilicate and feldspathic glass ceramic materials and was statistically greater than composite materials tested. The nanoceramic filler technology in Lava Ultimate Restorative allows it to retain polish similar to glass ceramics and superior to direct composites.
Lava™ Ultimate Restorative

Quantitative Analysis of Chipping on CAD/CAM-Milled Edges

J.C. ROLF, R. RUSIN and V.A. RUSSELL, 3M ESPE Dental, St. Paul, MN

Objectives: Compare edge integrity of CAD/CAM machined materials of CAD/CAM materials to a new Resin Nano Ceramic CAD/CAM material, 3M™ ESPE™ Lava™ Ultimate Restorative (LVU). LVU contains about 79 wt% nanoceramic particles that reinforce a highly crosslinked polymeric matrix.

Methods: Test bars (1.24 x 4 x 16mm) were milled on CEREC inLab MCXL in fast-mill mode. The 4mm edge was analyzed on 4 bars of each material via optical microscopy using an Olympus MX-61, with a 5X objective, dark field illumination mode for enhancing visibility of chip boundaries and image stitching for capturing the full length of each edge. The lengths (along the edge) and heights (perpendicular to edge) of chips were measured with the count and measure tool in the StreamEssentials™ image analysis software by Olympus. Data were analyzed via ANOVA with Tukey’s t-test (p < 0.05).

Results: Each 4mm edge contained between 12 – 30 chips, depending on the material. Average chip length, height and standard deviations for each group of materials are shown in the table. Each letter in column “SND” denotes groups that are statistically not different (SND) via ANOVA with Tukey’s t-test (p > 0.05).

<table>
<thead>
<tr>
<th>Material</th>
<th>Code</th>
<th>n</th>
<th>Mean Chip Length [µm] (SD)</th>
<th>SND</th>
<th>Mean Chip Width [µm] (SD)</th>
<th>SND</th>
</tr>
</thead>
<tbody>
<tr>
<td>3M™ ESPE™ Lava™ Ultimate Restorative (A2-LT)</td>
<td>LVU</td>
<td>4</td>
<td>58.07 (20.44)</td>
<td>A</td>
<td>21.63 (5.56)</td>
<td>A</td>
</tr>
<tr>
<td>3M™ ESPE™ Paradigm™ MZ 100 Block</td>
<td>MZ</td>
<td>4</td>
<td>85.57 (40.80)</td>
<td>B</td>
<td>31.44 (12.39)</td>
<td>B</td>
</tr>
<tr>
<td>Vitabloc™ Mark II for CEREC® inLab™</td>
<td>VM2</td>
<td>4</td>
<td>118.92 (51.38)</td>
<td>C</td>
<td>60.13 (22.03)</td>
<td>C</td>
</tr>
<tr>
<td>Ivoclar™ Empress™ CAD for CEREC® (A2-HT)</td>
<td>EMP</td>
<td>4</td>
<td>165.92 (80.7)</td>
<td>D</td>
<td>72.68 (32.35)</td>
<td>D</td>
</tr>
<tr>
<td>IPS e.max™ CAD for CEREC® (A2-LT)</td>
<td>EMX</td>
<td>4</td>
<td>128.81 (107.43)</td>
<td>C</td>
<td>98.08 (40.36)</td>
<td>E</td>
</tr>
</tbody>
</table>

Conclusions: The mean chip length and height on milled edges of the resin nanoceramic material LVU is smaller than those of MZ, VM2, EMP and EMX. LVU has improved edge chipping resistance compared to all tested materials. The improved edge quality may be attributed to LVU’s combination of high strength and low modulus (reported in another study), which allow the material to withstand milling stresses without suffering significant chipping damage. The edge quality helps support LVU’s use in demanding single-unit restorations.

Presenting author’s disclosure statement: Employee of 3M ESPE

3M ESPE Summary

Aim of Study: Compare edge integrity of CAD/CAM machined materials of CAD/CAM materials to a new Resin Nano Ceramic CAD/CAM material, 3M ESPE Lava Ultimate Restorative.

Summary of Results: Lava Ultimate Restorative has improved edge chipping resistance compared to the feldpathic and lithium disilicate glass-ceramics tested. The improved edge quality may be attributed to its combination of high strength and low modulus (reported in another study), which allow the material to withstand milling stresses without suffering significant chipping damage. The edge quality helps support the use of Lava Ultimate Restorative in demanding single-unit restorations.
Lava™ Plus High Translucency Zirconia

Translucency and Biaxial Flexural Strength of Dental Ceramics

F. WANG, Department of Prosthodontics, School of Stomatology, Fourth Military Medical University, Xi’an, China and H. TAKAHASHI, Oral Biomaterials Engineering, Tokyo Medical & Dental University, Bunkyo-ku, Japan

**Objectives:** As restorative materials, dental ceramics should have suitable translucency for excellent esthetics and adequate strength to resist stresses. As declared by the manufacturers, zirconia ceramics with improved translucency and new generation of lithium disilicate glass-ceramics have been launched into dental market, but less information is available for the translucent characteristic and mechanical properties of these materials. Therefore, the objective of the present study was to assess the translucency and flexural strengths of six dental ceramics.

**Methods:** Disk specimens (13mm in diameter and 0.60 ± 0.01mm in thickness) were prepared from following ceramics, including two lithium disilicate glass ceramics: IPS E.max Press MO1 (PMO) and IPS E.max CAD LT A2 (CLT) and four zirconia ceramics: Zenotec Bridge Trans (ZBT), Lava Standard (LVS), Lava Standard FS3 (LVF) and Lava Plus High Translucency (LVP), following the manufacturers’ instructions. A spectrophotometer was used to measure the translucency parameter (TP) of the specimens. The biaxial flexural strength was measured following the instructions of ISO 6872. TP values and biaxial flexural strength (MPa) were analyzed by one-way ANOVA, followed by Tukey’s multiple comparison test.

**Results:** TP values in order of most translucent to most opaque were as follows: CLT (23.9 ± 1.0), PMO (21.8 ± 0.4), LVP (15.0 ± 0.2), ZNT (13.7 ± 1.4) LVS (13.7 ± 0.1) and LVF (13.1 ± 0.7). There was no significant difference among ZNT, LVS and LVF (p > 0.05). Biaxial flexural strengths (MPa) from lower to higher were as follows: CLT (297 ± 51), PMO (423 ± 76), LVF (1289 ± 216), LVP (1275 ± 114), LVS (1368 ± 200) and ZNT (1398 ± 88). There was no significantly difference among four zirconia ceramics. (p > 0.05).

**Conclusions:** Two glass ceramics were significantly more translucent than zirconia ceramics, but with lower flexural strength. Among all zirconia ceramics, Lava Plus High Translucency showed improved translucency without compromising its mechanical properties. This abstract is based on research that was funded entirely or partially by an outside source: National Natural Science Foundation of China. (51002185)

**Keywords:** Ceramics, Color, Dental materials and Translucency

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3M ESPE Summary

**Aim of Study:** To investigate the translucency and bi-axial flexural strength of Lava Plus High Translucency Zirconia and Lava Frame Zirconia compared to other ceramics.

**Summary of Results:** Glass ceramics were found more translucent, however at a fraction of the flexural strength of zirconia. Lava Plus High Translucency Zirconia showed improved translucency without compromising its mechanical properties.

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http://iadr.confex.com/iadr/2012tampa/webprogram/
Lava™ Ultimate Restorative

Flexural Strength of a New Resin Nanoceramic CAD/CAM Material

R. RUSIN, V.A. RUSSELL, C.F. NORMAN and S.M. BROWN, 3M ESPE Dental, St. Paul, MN

Objectives: Determine the flexural strength, flexural modulus and modulus of resilience of a new Resin Nano Ceramic CAD/CAM material, 3M™ ESPE™ Lava™ Ultimate Restorative (LVU), compared with commercially available indirect and direct materials. LVU contains about 79 wt% nanoceramic particles that reinforce a highly crosslinked polymeric matrix.

Methods: Three-point flexural strength and modulus were measured according to ISO 6872, modified to accommodate bar sizes that could be sectioned from commercially available mill blocks. Polished 1 x 4 x 13.5mm bars were tested using a 10mm span and a crosshead speed of 1.0mm/minute. Modulus of resilience was calculated from the equation Ur = σ^2/(2E), where σ_y is the flexural strength and E the flexural modulus for each material. Data were analyzed via ANOVA with Tukey’s t-test (p < 0.05).

Results: Flexural strength, flexural modulus and modulus of resilience are shown in the table. Letters in column “SND Groups” denote groups that are statistically not different (SND) via ANOVA with Tukey’s t-test (p > 0.05).

<table>
<thead>
<tr>
<th>Material</th>
<th>Code</th>
<th>Flexural Strength, MPa (SD)</th>
<th>SND groups</th>
<th>Flexural Modulus, MPa (SD)</th>
<th>SND groups</th>
<th>Modulus of Resilience, MPa (SD)</th>
<th>SND groups</th>
<th>n</th>
</tr>
</thead>
<tbody>
<tr>
<td>3M™ ESPE™ Lava™ Ultimate Restorative (A2-HT)</td>
<td>LVU</td>
<td>204 (19)</td>
<td>A</td>
<td>12769 (992)</td>
<td>BC</td>
<td>1.64 (0.34)</td>
<td>A</td>
<td>20</td>
</tr>
<tr>
<td>3M™ ESPE™ Paradigm™ MZ100 Block</td>
<td>MZ</td>
<td>163 (17)</td>
<td>B</td>
<td>15749 (1901)</td>
<td>B</td>
<td>0.87 (0.22)</td>
<td>B</td>
<td>20</td>
</tr>
<tr>
<td>Ivoclar® IPS Empress® CAD</td>
<td>EMP</td>
<td>155 (17)</td>
<td>B</td>
<td>43658 (9159)</td>
<td>A</td>
<td>0.29 (0.08)</td>
<td>D</td>
<td>20</td>
</tr>
<tr>
<td>Vita® Vitabloc® Mark II Block</td>
<td>VM2</td>
<td>116 (11)</td>
<td>C</td>
<td>44197 (11063)</td>
<td>A</td>
<td>0.16 (0.06)</td>
<td>D</td>
<td>19</td>
</tr>
<tr>
<td>Ivoclar® Tetric® EvoCeram® Light-Curing Resin-Based Dental Restorative Material</td>
<td>TEC</td>
<td>106 (9)</td>
<td>C</td>
<td>9419 (759)</td>
<td>C</td>
<td>0.60 (0.09)</td>
<td>C</td>
<td>20</td>
</tr>
</tbody>
</table>

Conclusions: The flexural strength and resilience of the new resin nanoceramic material LVU are greater than those of MZ, EMP, VM2 and TEC. The flexural modulus of LVU is statistically lower than EMP and VM2 and statistically not different from MZ and TEC. The combination of high strength and low modulus give LVU a high resilience, as shown by its modulus of resilience, which is statistically significantly higher than other materials tested in this study. LVU can absorb significantly more stress than other materials without suffering permanent deformation or failure. The high strength of LVU helps support its use in demanding single-unit restorations, including posterior crowns and implant crowns.

Keywords: CAD/CAM, Ceramics, Dental materials, Prosthodontics and flexural strength

Presenting author’s disclosure statement: Presenter is employee of 3M ESPE.
Lava™ Ultimate Restorative (cont.)

3M ESPE Summary

_Aim of Study:_ Compare the flexural strength, flexural modulus and modulus of resilience of a new Resin Nano Ceramic CAD/CAM material, Lava Ultimate Restorative (LVU), with commercially available indirect and direct materials.

_Summary of Results:_ The flexural strength and resilience of the new resin nanoceramic material LVU are greater than those of MZ, EMP, VM2 and TEC. The flexural modulus of LVU is statistically lower than EMP and VM2 and statistically not different from MZ and TEC. The combination of high strength and low modulus give LVU a high resilience, as shown by its modulus of resilience, which is statistically significantly higher than other materials tested in this study. LVU can absorb significantly more stress than other materials without suffering permanent deformation or failure. The high strength of LVU helps support its use in demanding single-unit restorations, including posterior crowns and implant crowns.
Lava™ Ultimate Restorative

Fracture Toughness of a New Resin Nanoceramic CAD/CAM Material


Objectives: Determine the fracture toughness, Vickers Hardness and brittleness index of a new Resin Nano Ceramic CAD/CAM material, 3M™ ESPE™ Lava™ Ultimate Restorative (LVU), compared with commercially available indirect and direct materials. LVU contains about 79 wt% nanoceramic particles that reinforce a highly crosslinked polymeric matrix.

Methods: Fracture toughness was measured via the single-edge V-notched beam (SEVNB) method of ISO 6872, modified to accommodate bar sizes that could be sectioned from commercially available mill blocks. A V-notch was cut in 3mm x 4mm x 14mm bars, which were tested on a 3-point fixture with a 10mm span and a crosshead speed of 0.5mm/minute. Vickers hardness was measured according to ASTM C1327-08 on mounted and polished specimens (10 indents on each material). Brittleness Index, B, was calculated from $B = \frac{H_vE}{K_i^2}$, where $H_v$ is Vickers hardness, E is flexural modulus (reported in another study) and $K_i$ is fracture toughness. Data were analyzed via ANOVA with Tukey’s t-test ($p < 0.05$).

Results: Letters in column “SND Groups” denote groups that are statistically not different (SND) via ANOVA with Tukey’s t-test ($p > 0.05$).

<table>
<thead>
<tr>
<th>Material</th>
<th>Code</th>
<th>Fracture Toughness MPa-m$^{1/2}$ (SD)</th>
<th>SND groups</th>
<th>n</th>
<th>H, kg/mm$^2$ (SD)</th>
<th>SND groups</th>
<th>n</th>
<th>B, µm (SD)</th>
<th>SND groups</th>
</tr>
</thead>
<tbody>
<tr>
<td>3M™ ESPE™ Lava™ Ultimate Restorative (A2-HT)</td>
<td>LVU</td>
<td>2.02 (0.15)</td>
<td>A</td>
<td>10</td>
<td>107.3 (1.4)</td>
<td>C</td>
<td>10</td>
<td>3.8 (0.1)</td>
<td>C</td>
</tr>
<tr>
<td>3M™ ESPE™ Paradigm™ MZ100 Block</td>
<td>MZ</td>
<td>1.64 (0.15)</td>
<td>B</td>
<td>10</td>
<td>134.2 (2.4)</td>
<td>C</td>
<td>10</td>
<td>7.8 (0.1)</td>
<td>C</td>
</tr>
<tr>
<td>Ivoclar® IPS Empress CAD</td>
<td>EMP</td>
<td>1.44 (0.10)</td>
<td>D</td>
<td>10</td>
<td>535.5 (42.2)</td>
<td>B</td>
<td>10</td>
<td>112.5 (8.9)</td>
<td>B</td>
</tr>
<tr>
<td>VITA® Vitabloc® Mark II Block</td>
<td>VM2</td>
<td>1.45 (0.09)</td>
<td>CD</td>
<td>8</td>
<td>613.0 (40.0)</td>
<td>A</td>
<td>10</td>
<td>128.1 (8.4)</td>
<td>A</td>
</tr>
<tr>
<td>Ivoclar® Tetric® EvoCeram® Light-Curing</td>
<td>TEC</td>
<td>1.63 (0.15)</td>
<td>BC</td>
<td>10</td>
<td>61.6 (0.9)</td>
<td>D</td>
<td>10</td>
<td>2.2 (0.0)</td>
<td>C</td>
</tr>
</tbody>
</table>

Conclusions: The fracture toughness of the new resin nanoceramic material LVU is statistically higher than feldspathic glass-ceramics EMP and VM2 and composite materials MZ and TEC. Vickers hardness of EMP and VM2 is statistically higher than LVU, MZ and TEC. The combination of high fracture toughness, low hardness and low modulus makes LVU and the composite materials much less brittle than feldspathic glass-ceramics, as shown by the statistically significant differences in brittleness index. Low brittleness may make these materials less prone to cracking during try-in and function.

Presenting author’s disclosure statement: Employee of 3M ESPE

3M ESPE Summary

Aim of Study: Compare the fracture toughness, Vickers Hardness and brittleness index of a new Resin Nano Ceramic CAD/CAM material, Lava Ultimate Restorative (LVU), with commercially available indirect and direct materials.

Summary of Results: The combination of high fracture toughness, low hardness and low modulus makes Lava Ultimate Restorative much less brittle than feldspathic glass-ceramics, as shown by the statistically significant differences in brittleness index. Low brittleness may make these materials less prone to cracking during try-in and function.

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http://iadr.confex.com/iadr/2012tampa/webprogram/
Shear-Bond Strength of Adhesive Resin Cements to Different Restoration Materials

C.A. WIEDIG, R. HECHT, G. RAIA, M. LUDSTECK and C. THALACKER, 3M ESPE, Seefeld, Germany

Objectives: The purpose of this in-vitro investigation was to compare shear bond strength (SBS) of different adhesive resin cements and their pre-treatment procedures to Titanium, Ni-Cr-Alloy (Remanium®) and Resin Nano Ceramic (RNC, Lava™ Ultimate Restorative).

Methods: Materials tested were Multilink® Automix, Variolink® II (both Ivoclar-Vivadent), Panavia™ F2.0, Clearfil™ Esthetic Cement (both Kuraray), NX3 (Kerr), RelyX™ Ultimate Adhesive Resin Cement (3M ESPE).

For shear bond strength (SBS) testing, Titanium, Remanium and RNC specimens were pre-treated as recommended by manufacturers’ instructions. Stainless steel rods (diameter 4mm) were cemented under standardized pressure (20 g/mm²) onto the restoration material specimens and light-cured (RNC) or dark-cured (Titanium, Remanium) following the manufacturers’ instructions. RelyX Ultimate Adhesive Resin Cement was used with Scotchbond™ Universal Adhesive (3M ESPE) that serves both as tooth bonding agent and restoration primer. Specimens were stored for 24 hours at 36°C and 100% relative humidity. Half of the specimens were artificially aged (5.000 thermal cycles, 5°C – 55°C, 30 seconds dwell time).

SBS was measured using a universal testing machine (Zwick Z010, crosshead speed: 0.75mm/minute). Data obtained were analyzed using Multiple Range Test (Fisher’s LSD; p < 0.05; n = 6).

Results: See table. Values in one column marked with the same superscript characters are not statistically different.

<table>
<thead>
<tr>
<th>Materials</th>
<th>Titanium sc</th>
<th>Remanium sc</th>
<th>Lava Ultimate lc</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>24 hours</td>
<td>5000TC</td>
<td>24 hours</td>
</tr>
<tr>
<td>Clearfil Esthetic Cement/AlloyPrimer</td>
<td>9.8 ± 1.7a</td>
<td>38.5 ± 8.9a</td>
<td>9.5 ± 4.7a</td>
</tr>
<tr>
<td>Multilink Automix/Monobond Plus</td>
<td>38.1 ± 5.2c</td>
<td>36.7 ± 4.4b</td>
<td>35.9 ± 3.7a</td>
</tr>
<tr>
<td>Panavia F2.0/—/—/ClearfilCeramicPrimer</td>
<td>32.1 ± 2.3c</td>
<td>42.7 ± 8.5c</td>
<td>34.0 ± 2.9b</td>
</tr>
<tr>
<td>NX3/—/—/Silane Primer</td>
<td>31.6 ± 3.4b</td>
<td>19.9 ± 1.1a</td>
<td>25.5 ± 3.6a</td>
</tr>
<tr>
<td>RelyX Ultimate/Scotchbond Universal</td>
<td>52.1 ± 5.8c</td>
<td>50.9 ± 3.0c</td>
<td>44.3 ± 3.3c</td>
</tr>
<tr>
<td>Variolink II/Monobond Plus</td>
<td>—</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>RelyX Ultimate/RelyX Ceramic Primer</td>
<td>—</td>
<td>—</td>
<td>—</td>
</tr>
</tbody>
</table>

Conclusions: RelyX Ultimate Adhesive Resin Cement and its dedicated pre-treatment protocol with Scotchbond Universal Adhesive shows highest adhesion values to all tested restoration materials.

Keywords: Adhesion, Cements, Dental materials and Metals

Presenting author’s disclosure statement: Employee of 3M ESPE
Lava™ Ultimate Restorative (cont.)

3M ESPE Summary

**Aim of Study:** Compare shear bond strength (SBS) of various adhesive resin cements and their pre-treatment procedures to Titanium, Ni-Cr-Alloy (Remanium®) and Resin Nano Ceramic (RNC, Lava™ Ultimate Restorative).

**Summary of Results:** RelyX Ultimate Adhesive Resin Cement and its dedicated pre-treatment protocol with Scotchbond Universal Adhesive shows highest adhesion values to all tested restoration materials.
Staining Intensity of CAD/CAM Materials Versus Direct Composites

A. ALHARBI, Dental School, University of Geneva, Geneva, Switzerland, S. ARDU, University of Geneva, Geneva, Switzerland, T. BORTOLOTTO, Université de Genève, Geneve, Switzerland and I. KREJCI, Dept. de Medecine Dentaire, University of Geneva, Geneva, Switzerland

Objectives: To evaluate the staining intensity of CAD/CAM and direct restorative materials when continuously exposed to various staining agents.

Methods: Disk-shaped samples were fabricated out of 8 materials (5 CAD/CAM and 3 direct composite materials). Samples were stored in distilled water for 24 hours at 37°C in an incubator (INP-500, Memmert), then randomly divided into five groups (n = 8) according to the different staining solutions (distilled water, tea, red wine, coffee and artificial saliva). Initial L*a*b* values were assessed by calibrated spectrophotometer against white and black background. Samples were immersed in staining solution and stored in an incubator at 37°C for 60 days. The test solutions were replaced every 12 days to avoid bacteria and yeast contamination. Before the color measurements, samples were rinsed for 60 seconds with a high-pressure hot-water airbrush and air dried. L*a*b* values were assessed again after 60 days of staining and values were recorded and deltaE values were calculated. ANOVA and Tukey test were used to specifically identify differences between groups a = 0.05.

Results: Significant differences were detected by ANOVA (p = 0.000) for deltaE values against black and white backgrounds. Red wine proved to have the highest staining potential followed by coffee, tea, artificial saliva and distilled water. Filtek™ Supreme XTE Universal Restorative was the least color stable among the materials tested. Enamic showed better color stability than Vita MK II. Filtek™ Silorane Low Shrink Posterior Restorative showed an intermediate result between the CAD/CAM materials and the other direct composites.

Conclusions: Both, ceramic and composite CAD/CAM materials had a lower staining susceptibility than direct composites. Staining intensity was highly affected by colorants.

3M ESPE Summary

Aim of Study: Compare the staining resistance of CAD/CAM and direct restorative materials under continuous exposure to various staining challenges.

Summary of Results: Red wine produced the highest degree of staining, followed by coffee, tea, artificial saliva and distilled water. Filtek Silorane composite displayed an intermediate result between the CAD/CAM materials and the other direct composites. The ceramic and resin nanoceramic CAD/CAM materials displayed higher stain resistance than the direct composites tested.

Adhesion of Indirect Ceramic and Composite Restorations: Influence of Chewing

G. TURCO, A. FRASSETTO, G. MARCHESI, I. SPAGNOLO, C. NAVARRA, R. DI LENARDA, M. CADENARO and L. BRESCHI, Department of Medical Sciences, University of Trieste, Trieste, Italy

Objectives: The purpose of this study was to evaluate the influence of simulated chewing forces on bond strength of ceramic and composite disks luted to dentin with a simplified cement [Scotchbond™ Universal Adhesive and RelyX™ Ultimate Adhesive Resin Cement, 3M ESPE] or a multi-step cement [Variolink II, Ivoclar-Vivadent]).

Methods: Eighty noncarious human molars were cut with a low speed diamond saw under water cooling and equally and randomly assigned to two main groups: CS (Chewing Simulation) and Controls (Static Conditions). Specimens were then divided in 4 different luting groups (N = 20): Group 1: Ceramic disks (Feldspathic Ceramic, Vita Mark II, Vita) luted with Scotchbond Universal Adhesive and RelyX Ultimate Adhesive Resin Cement; Group 2: Ceramic disks (Feldspathic Ceramic, Vita Mark II) luted with Variolink II; Group 3: Composite disks (Lava™ Ultimate Restorative, 3M ESPE) and Scotchbond Universal Adhesive and RelyX Ultimate Adhesive Resin Cement; Group 4: Composite disks (Lava Ultimate Restorative) and Variolink II. Specimens were then either submitted to chewing simulation or stored in water and subsequently cut for microtensile bond strength analysis in accordance with the non-trimming technique. Sticks were stressed until failure with a simplified universal testing machine. Data were statistically analyzed by Student’s T Test (p = 0.05).

Results:

<table>
<thead>
<tr>
<th>Luted Material</th>
<th>Cement</th>
<th>Storage</th>
<th>CS</th>
<th>Control</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ceramic</td>
<td>SU&amp;RU</td>
<td>CS</td>
<td>12.1 (4.4)ᵃ</td>
<td>14.3 (4.7)ᵇ,ᶜ</td>
</tr>
<tr>
<td>Ceramic</td>
<td>VII</td>
<td>CS</td>
<td>13.5 (4.7)ᵇ</td>
<td>16.1 (4.3)ᶜ,d</td>
</tr>
<tr>
<td>Composite</td>
<td>SU&amp;RU</td>
<td>CS</td>
<td>12.6 (4.7)ᵇ</td>
<td>13.2 (5.3)ᵇ</td>
</tr>
<tr>
<td>Composite</td>
<td>VII</td>
<td>CS</td>
<td>14.9 (5.3)ᵇ,c</td>
<td>17.8 (5.1)ᵈ</td>
</tr>
</tbody>
</table>

Table 1: Means and standard deviations (SD) of microtensile bond strength (MPa) obtained at luted material/dentin interface. Different superscript letters indicate statistical differences between the groups (p < 0.05).

Conclusions: The simplified luting procedure (Scotchbond Universal Adhesive and RelyX Ultimate Adhesive Resin Cement) exhibited comparable bond strength values for both ceramic and composite irrespective from the aging conditions (both CS and Static). Albeit the strength values were slightly higher before chewing simulation, the multi-step cement (Variolink II) was significantly affected by chewing. Further studies are needed to clarify the role of occlusal forces on ceramic bond to dentin. Supported, in part, by grants: FIRB RBAP1095CR and PRIN 2009SAN9K5 and 2009FXT3WL from MIUR, Italy.

This abstract is based on research that was funded entirely or partially by an outside source: FIRB RBAP1095CR, 2009SAN9K5 and 2009FXT3WL from MIUR, Italy

Keywords: Adhesion, Cements, Ceramics, Composites and Mastication

continued on next page >
Lava™ Ultimate Restorative (cont.)

3M ESPE Summary

**Aim of Study:** Determine the effect of chewing fatigue on the microtensile bond strength of Vita Mark II and Lava™ Ultimate Restorative bonded to dentin with RelyX™ Ultimate Adhesive Resin Cement (used with Scotchbond™ Universal Adhesive) or Variolink II cement.

**Summary of Results:** The bond strength of RelyX Ultimate Adhesive Resin Cement was not statistically different before and after chewing simulation with both Lava Ultimate Restorative and Vita Mark II; bond strength of Variolink II was statistically lower after chewing simulation with both Lava Ultimate Restorative and Vita Mark II. The bond strength of Lava Ultimate and Vita Mark II was not statistically different for each cement and aging condition. After chewing simulation the bond strengths of Lava Ultimate Restorative and Vita Mark II were not statistically different for with each cement.
Lava™ Plus High Translucency Zirconia

Wear Behavior of a New Zirconia after Hydrothermal Accelerated Aging

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Objectives: Zirconia ceramics with higher translucency are suitable for monolithic dental restorations. Aim of this study was in vitro wear characterization after hydrothermal accelerated aging of a new zirconia.

Methods: Steatite spheres were used as antagonists (Ceramtec, Ø 6mm). 3M™ ESPE™ Lava™ Plus High Translucency Zirconia (LPZ) and 3M ESPE experimental veneering material (VM) were used as initial material groups (n = 4). VM samples were tested with 9μm diamond suspension polished surface. LPZ samples were tested polished (LPZp) and with as fired surface (LPZr). Groups (n = 4) of LPZp and LPZr were hydrothermally aged in a steam autoclave at 135°C, 2 bar for 5 hours and 30 hours respectively.

Spheres and samples were fixed in a longitudinal moving abrasion test device (Elcometer 1720). Spheres were slid under water across material plates at a constant load of 5N (path length 32mm, 37 cycles/minute for 120 minutes).

X-ray measurements were performed by micro diffraction (diameter 200μm) in Bragg-Brentano geometry (Bruker D8 Discover) and semi-quantitative phase analysis of monoclinic phase (M) was done by the Rietveld method (Bruker TOPAS software).

Waviness depth (Wd) after abrasion was determined by profilometry (Mahr S2) at 6 positions per sample and surface roughness was measured before (Ra0) and after abrasion (Ra1). Sphere abrasion was measured by microscopy (Zeiss SV11) and volume loss (Vl) was calculated.

Results: Mean values (SD) for Vl, Wd, Ra0, Ra1 and M are summarized in following table. For Vl two sample t-tests (p < 0.05) were performed between the groups.

<table>
<thead>
<tr>
<th></th>
<th>VM</th>
<th>LPZp</th>
<th>LPZp 5 hours aged</th>
<th>LPZp 30 hours aged</th>
<th>LPZr</th>
<th>LPZr 5 hours aged</th>
<th>LPZr 30 hours aged</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vl [mm³]</td>
<td>0.18 (0.01)</td>
<td>0.04 (0.03)</td>
<td>0.06 (0.00)</td>
<td>0.04 (0.03)</td>
<td>0.15 (0.03)</td>
<td>0.16 (0.03)</td>
<td>0.19 (0.03)</td>
</tr>
<tr>
<td>Wd [µm]</td>
<td>15.94 (1.80)</td>
<td>0.20 (0.18)</td>
<td>0.13 (0.01)</td>
<td>0.12 (0.02)</td>
<td>0.43 (0.24)</td>
<td>0.62 (0.36)</td>
<td>1.04 (0.38)</td>
</tr>
<tr>
<td>Ra0 [µm]</td>
<td>0.09 (0.00)</td>
<td>0.01 (0.00)</td>
<td>0.01 (0.00)</td>
<td>0.01 (0.00)</td>
<td>0.15 (0.02)</td>
<td>0.16 (0.01)</td>
<td>0.17 (0.02)</td>
</tr>
<tr>
<td>Ra1 [µm]</td>
<td>0.17 (0.07)</td>
<td>0.01 (0.00)</td>
<td>0.01 (0.00)</td>
<td>0.01 (0.00)</td>
<td>0.09 (0.01)</td>
<td>0.09 (0.02)</td>
<td>0.20 (0.03)</td>
</tr>
<tr>
<td>M [wt. %]</td>
<td>—</td>
<td>0</td>
<td>2</td>
<td>11</td>
<td>0</td>
<td>16</td>
<td>59</td>
</tr>
</tbody>
</table>

Work and Fmax were evaluated by linear regression for their correlation with instrument stringiness rating at either condition. Work correlated best with stringiness, R² = 71% for 1 second and 8mm/second and R² = 73% for 20 seconds and 1mm/second.

Conclusions: The VM has shown a statistically significant higher antagonist wear compared to Lava Plus High Translucency Zirconia LPZp before and after aging. Hydrothermal accelerated aging induced monoclinic crystal phase at the outer sample surface of LPZ, however wear properties did not show a significant change for LPZp and LPZr.

Presenting author’s disclosure statement: I’m an employee of 3M ESPE.
Lava™ Plus High Translucency Zirconia (cont.)

3M ESPE Summary

Aim of Study: To investigate the in vitro wear properties of Lava™ Plus High Translucency Zirconia before and after hydrothermal aging in comparison to a state-of-the-art veneering porcelain.

Summary of Results: Lava Plus High Translucency Zirconia was found more antagonist friendly than the veneering porcelain. Wear properties of Lava Plus Zirconia were not significantly affected by aging.
Lava™ Plus High Translucency Zirconia

Contrast Ratios of Uncolored and Colored Zirconia Materials

G. SCHECHNER, R. DITTMANN, A. FISCHER and H. HAUPTMANN, 3M ESPE, Seefeld, Germany

Objectives: Translucency combined with high strength is a major advantage of zirconia restorations. Also, the possibility to shade zirconia turned out to be an important feature for frameworks but particularly for full contour indications. Aim of this study is to characterize the translucency of colored and uncolored zirconia materials — all claimed to be highly translucent — by their contrast ratio (CR) respective opacity.

Methods: Fully sintered zirconia sample disks (thickness 1mm, diameter 14mm) were prepared according to manufacturer’s instructions. N = 5 for each group. Surfaces on both sides were finally polished with 3μm diamond suspension. Uncolored group: LP: Lava Plus High Translucency Zirconia (3M ESPE), HT: Crystal HT (Dental Laboratory Milling Supplies), WZ: Zentotec Bridge Translucent (Wieland), ZH: Translucent ICE (Zirkonzahn). Colored group: Zirconia materials as above with the following shading liquids: LPA3: Lava Plus High Translucency Zirconia A3 (3M ESPE), HTA3: Prettau A3 (Zirkonzahn), WZA3: Zr A3 (Wieland), ZHA3: Color Liquid A3 (Zirkonzahn). CR was recorded on a photospectrometer Color i7 (X-Rite Corp.), D65 lamp. Measuring mode: Remission contrast ratio. Aperture: 10mm. Specula: excluded. UV irradiation: on.

Results: CR of uncolored zirconia materials (Fig.1): LP 69.0% [0.4], HT 70.3% [1.9], WZ 70.0% [0.9], ZH 74.4% [1.3]. CR of ZH is significantly lower compared to the others. CR of colored materials (Fig. 2): LPA3 76.8% [0.2], HTA3 79.7% [1.14], WZA3 83.2% [0.2], ZHA3 88.0% [1.3]. CR values of all colored groups are significantly different to each other.

Conclusions: Within the uncolored zirconia materials differences in their translucency can be detected; as a trend between LP, HT and WZ, significantly between ZH and all others. However, since zirconia commonly is used in its colored form, the detected significant differences between all colored materials are of particular relevance. So, this study gives a valuable guideline to the practitioner to select a colored zirconia material with a translucency of his choice.

Presenting author’s disclosure statement: Employee of 3M.
Lava™ Plus High Translucency Zirconia (cont.)

3M ESPE Summary

**Aim of Study:** To compare the translucency of shaded and unshaded zirconia materials.

**Summary of Results:** Shading leads to a loss in translucency. Within the materials investigated Lava Plus High Translucency Zirconia System was best able to maintain translucency in the shaded state.
Lava™ Ultimate Restorative

Flexural Strength of Resin Nano-Ceramic Material Versus Other CAD/CAM Materials

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Objectives: The objective of this study was to compare the flexural strength of 8 CAD/CAM materials.

Methods: Ten bars, 15mm x 3.5mm x 1.5mm, were made of 2 provisional restorative materials, CAD-temp (Vita) (group 1) and Telio CAD (Ivoclar) (group 2); 2 feldspathic ceramic materials, Mark II (Vita) (group 3) and ProCAD (Ivoclar) (group 4); 2 glass ceramic materials, e.max CAD (Ivoclar) (group 5) and Empress CAD (Ivoclar) (group 6); 1 resin-based composite material, Paradigm™ MZ100 Block (3M ESPE) (group 7); and an experimental resin nano-ceramic material (3M ESPE) (group 8). Bars were cut from CAD/CAM blocks with a saw (Isomet; Buehler) and were tested with a 3-point bending test in a universal testing machine (5566A, Instron) with a 1-kN cell, a 0.5mm/minute cross-head speed and a 10mm span. Results were analyzed with ANOVA followed by Tukey HSD test ($\alpha = 0.05$).

Results: Means and standard deviations of flexural strength values (MPa) were: (group 1) 102.09 ± 5.07; (group 2) 181.49 ± 7.99; (group 3) 95.58 ± 9.09; (group 4) 373.82 ± 63.09; (group 5) 88.01 ± 35.28; (group 6) 103.26 ± 16.19; (group 7) 183.09 ± 22.69 and (group 8) 233.91 ± 12.19. The e.max CAD material recorded a significantly higher mean flexural than all other materials. The resin nano-ceramic material recorded the second highest strength. There was no statistically significant difference between the Paradigm MZ100 Block and Telio CAD materials and no statistically significant differences among ProCAD, CAD-temp, Mark II and Empress CAD materials.

Conclusions: Within the limitations of this study, it was concluded that the experimental material demonstrated the second highest mean value for flexural strength. Paradigm MZ100 Block and Telio Cad recorded higher flexural strengths than some ceramic materials.

Keywords: CAD/CAM, Dental materials and Resin Nano-Ceramic

3M ESPE Summary

Aim of Study: Compare the flexural strength of CAD/CAM materials.

Summary of Results: The flexural strength of Lava Ultimate Restorative (the experimental resin nano ceramic material) was greater than Empress CAD, Vita Mark II, ProCAD, Paradigm MZ100 Block, CAD Temp and Telio CAD.
Durability of Resin Bond Strength to Ceramic after Surface Treatments

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Objectives: The aim of the present study was the evaluation of the bond strength and durability effect of two luting cements to zirconium-reinforced ceramic after using different surface treatments.

Methods: Forty square-shaped zirconium-oxide ceramic blocks (Lava Zirconia, 3M ESPE) were treated as follows: (C) polished, with no surface treatment (control); (HF) etching using 9.5% hydrofluoric acid for 1 minute; (SB) sandblasting using 110μm aluminum oxide particles, (SC) blasting using 110μm aluminum oxide particles modified by silica (silica coating) and (AP) sandblasting using 110μm aluminum oxide particles and one coat of an alloy primer. Two luting agents were individually applied on the treated ceramic surface: self-adhesive (RelyX™ U100 Self-Adhesive Universal Resin Cement — 3M ESPE) and dual cure (RelyX™ ARC Cement — 3M ESPE). After 24 hours and 180 days, each sample was submitted to microshear using speed of 1.0mm/minute and the failure mode of the ceramic-cement interface was evaluated in a stereomicroscope. Results were submitted to ANOVA and Tukey test (p = 0.05).

Results: To the bond strength, results ranged from 10.82 (HF) to 25.66 MPa (AP) for ARC. AP and SC were both statistically superior to the other treatments and HF was associated with a statistically lower mean value compared to the other groups. After 180 days, the results ranged from 2.10 (HF) to 23.68 (SC), AP and SC the superior statistically to the others treatments. For U100, results ranged between 11.45 (HF) and 25.87 MPa (SC). SC and HF were related to mean values of bond strength statistically higher and lower compared to the other methods, respectively. After 180 days, results ranged between 0.59 (HF) and 21.13 (SC).

Conclusions: Ceramic surface treatments presented significant influence on the bond strength of the cement-ceramic interface. In this sense, silica coating and sandblasting plus alloy primer were associated with the best treatments of the ceramic surface.

3M ESPE Summary

Aim of Study: To compare shear bond strength of resin cements to Lava Frame Zirconia after HF etching and sandblasting, respectively.

Summary of Results: HF etching is not an effective surface pre-treatment for Lava Frame Zirconia. Sandblasting pre-treatment leads to a reliable bond.

Please note: As per the instructions for use the recommended cementation pre-treatment of Lava Frame Zirconia restorations is sandblasting with alumina oxide, particle size 50μm or less.
Lava™ Frame Zirconia

Failure Behaviour of Zirconia-Based Fixed Partial Dentures

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Objectives: To evaluate the effect of the ceramic material on the fracture load and fracture behavior of fixed partial dentures (FPDs).

Methods: Two yttria partially stabilized tetragonal zirconia (Y-TZP) ceramics were evaluated: LV — Lava Zirconia Frame (3M ESPE); and ZR — Zircar Blocks (Zircar Zirconia, Inc). Steel models simulating prepared abutment teeth were constructed to design the FPDs. Ten FPDs were produced for each material with a 9mm² connector cross-section. The frameworks were built using CAD-CAM technology (LV — Lava Scan and Milling Machine, ZR — CEREC inLab) and were veneered with a uniform thickness of 1.2mm in the crowns and pontic areas and 6.0mm around the connector with Vita VM9 porcelain. A layer of bonding agent (Effect Bonder, Vita) was applied and sintered over the frameworks before porcelain veneering. FPDs were cemented in the metal dies with zinc phosphate cement. All FPDs were tested in a universal testing machine with the load being applied by a stainless steel sphere in the center of the pontic with 0.5mm/min crosshead speed until failure and in a 37°C distilled water bath. Fracture surfaces were examined using stereomicroscope. Data were statistically analyzed using t test (\( p \geq 0.05 \)).

Results: The mean fracture load (N) and standard deviation values for the experimental groups were: (LV) 2011N ± 180N; (ZR) 2232N ± 323N. There was no significant difference between the two groups (\( p \geq 0.05 \)). All fractures started at the gingival side of the connector propagating throughout the pontic towards the occlusal surface. Fractography showed different fracture planes for the framework and porcelain layer, suggesting that a surface flaw grew to critical size in the veneer porcelain, deflected at the veneer-core interface and fractured catastrophically through the core material.

Conclusions: The Y-TZP framework materials evaluated showed similar fracture load values and failure behaviour. This abstract is based on research that was funded entirely or partially by an outside source: CAPES, CNPq and Fapesp (Brazil)

Keywords: Biomechanics, CAD/CAM, Ceramics and Dental materials

3M ESPE Summary

Aim of Study: Measure the fracture load and failure mode of veneered Y-TZP bridges.

Summary of Results: Both types of Y-TZP bridges investigated showed high fracture loads with mean values above 2000 N and similar failure modes.
Lava™ Ultimate Restorative

Bond Strength of Composites to Resin Nano Ceramics

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Objectives: Since layering composites to monocromatic CAD/CAM resin nano ceramic material either for improved esthetics, anatomical changes or even repair may be needed, this study sought to evaluate the microtensile bond strength of direct and indirect resin composites to it.

Methods: Ten resin nano ceramic blocks (Lava Ultimate Restorative, 3M ESPE, USA) were polished to a 600 grit silicon carbide paper, sandblasted (50μm Al2O3) and cleaned in a ultrasonic bath. A one-step total-etch adhesive (Adper™ Easy Bond Self-Etch Adhesive, 3M ESPE, USA) was applied, 30 seconds allowed for solvent evaporation and then light-cured for 10 seconds. An indirect composite (n = 5 blocks, Ceramage, Shofu Dental Corporation, Kyoto, Japan) or a direct composite (n = 5 blocks, Filtek™ Supreme, 3M ESPE) was incrementally packed (1.5mm), light-cured for 60 seconds and longitudinally sectioned with a diamond saw under water irrigation. Hourglass-shaped samples with an approximate 0.5mm2 cross-section area were prepared with a ultrafine diamond bur and tested in a microtensile mode at 0.5mm/minute.

Results: Mean bond strength values were 80.15 ± 17.83 and 81.72 ± 15.31 MPa for Ceramage and Filtek Supreme, respectively. No statistical difference was detected between groups (T-tests, p < 0.05).

Conclusions: Both direct and indirect resin composite materials bonded to resin nano ceramic CAD/CAM blocks presented mean bond strength values that were not statistically different and may be suitable for veneering or repair, if needed.

Keywords: Adhesion, CAD/CAM, Composites, Dental materials and Polymers

3M ESPE Summary

Aim of Study: Determine the microtensile bond strength of direct and indirect resin composites to Lava Ultimate Restorative.

Summary of Results: The microtensile bond strengths of direct and indirect resin composites to Lava Ultimate Restorative were not statistically different and may be suitable for esthetic characterization or intraoral service.


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**Objectives:** To evaluate the reliability and failure modes of implant-supported resin nano ceramic relative to metal-ceramic crowns.

**Methods:** 21 resin nano ceramic (LU) (Lava Ultimate Restorative, 3M ESPE, USA) molar crowns were CAD/CAM produced and 21 metal-ceramic (MC) (Co-Cr alloy, Wirobond C+, Bego, USA) with identical anatomy were fabricated. The metal coping and a burnout-resin veneer were created by CAD/CAM, using the abutment (Stealth-abutment, Bicon, USA) and a milled crown from the LU group as models for porcelain hot-pressing (GC-Initial IQ-Press, GC, USA) onto the metal. Crowns were cemented (IAC® — integrated abutment crown), placed in the implants (n = 42, Bicon), embedded in acrylic-resin for mechanical testing and subjected to single-load to fracture (SLF, n = 3 each) for determination of step-stress profiles for accelerated-life testing in water (n = 18 each). Weibull curves (50,000 cycles at 200N, 90% CI) were plotted. Weibull modulus ($m$) and characteristic strength ($\eta$) were calculated and a contour plot used ($m$ vs. $\eta$). Fractography was performed in SEM and light-microscopy.

**Results:** SLF mean values were 1871N (± 54) for MC and 1748N (± 50.7) for LU. Beta values were 0.11 for MC and 0.49 for LU, (failures not influenced by fatigue and damage accumulation). The data replotted as Weibull distribution showed a $m = 9.56$ and $\eta = 1038.8N$ for LU and $m = 4.57$ and $\eta = 945.42N$ for MC ($p > .10$). The higher $m$ for LU suggests that flaws were more uniformly distributed throughout the material resulting in failures occurring in a more anticipated load range than MC. Reliability (50,000 cycles at 200N) was 100% for LU and 99% for MC. Failures were cohesive within LU and exposed the metal coping in the MC crowns. Fractures initiated from the occlusal indentation area and propagated towards the margins of the fracture.

**Conclusions:** Reliability was not significantly different between implant-supported resin nano ceramic and metal-ceramic molar crowns. Failure modes differed.

This abstract is based on research that was funded entirely or partially by an outside source: 3M ESPE, Bicon Dental Implants

**Keywords:** CAD/CAM, Composites, Implants, Loading and metal ceramic

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**3M ESPE Summary**

**Aim of Study:** Compare the reliability and failure modes of Lava Ultimate Restorative to metal-ceramic when used for implant-supported crowns.

**Summary of Results:** The reliability of Lava Ultimate Restorative implant-supported crowns was not statistically different from that of metal-ceramic. Reliability was not significantly different between implant-supported resin nano ceramic and metal-ceramic molar crowns. Failures in the Lava Ultimate Restorative were cohesive within the material, whereas failures in the metal-ceramic exposed the metal coping.
Paradigm™ MZ100

Fatigue Resistance and Crack Propensity of Large MOD Composite-Resin Restorations
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Objectives: To compare the influence of composite-resin restorative techniques (CAD/CAM inlays, direct composite-restorations and a modified sandwich-restorations) for large MOD defects and its effect on shrinkage-induced crack propensity and accelerated fatigue resistance.

Methods: A standardized MOD tooth preparation was applied to 62 extracted maxillary molars (5mm depth and 5mm bucco-palatal width). Teeth were randomly distributed in 4 groups (n = 15): Paradigm MZ100 inlays fabricated in CEREC 3 (MZ100 group); incremental and conventional direct-composite-resin restoration (M2 group); a modified “super-closed” sandwich technique (bonding agent was applied first followed by 2 different bases (conventional glass-ionomer-cement — GIC — KM group-, or a resin-modified-GIC — FJ group) covered by a direct composite-resin. Two MZ100 specimens were used as a guide to copy occlusal anatomy. After restorations, teeth were immersed in distilled water for 1 week and submitted to cyclic isometric chewing (5Hz), starting with a load of 200N (5,000 cycles), followed by stages of 400, 600, 800, 1000, 1200 and 1,400N at a maximum of 30,000 cycles each. Samples were loaded until fracture or to a maximum of 185,000 cycles. Groups were compared using the life table survival analysis. Cracks induced by polymerization shrinkage were tracked by a novel method using transillumination and were classified according to their severity.

Results: MZ100 survived 100% and had almost no crack propensity. FJ showed the highest survival amongst direct techniques (40% intact) but did not differ from KM group (20%) or M2 group (13%). Sandwich restorations generated less shrinkage-induced cracks. Conventional composite-resin group had the highest crack propensity and most severe cracks.

Conclusions: MZ100 inlays increased the accelerated fatigue resistance and decreased the crack propensity when compared to all direct-restorations. Inclusion of GIC/RMGIC bases under large direct composite-resin restorations does not affect their fatigue strength and decrease the shrinkage-induced enamel crack propensity compared to direct composite-resin restorations.

This abstract is based on research that was funded entirely or partially by an outside source: Capes (238310-1)

Keywords: CAD/CAM, Composites, Fatigue resistance, Glass ionomers and Polymerization

3M ESPE Summary

Aim of Study: Compare the fatigue resistance and shrinkage-induced crack propensity of three different resin composite techniques — CAD/CAM inlays, direct composite-restorations and a modified sandwich-restoration — in large MOD restorations.

Summary of Results: The fatigue resistance was higher and crack propensity lower for Paradigm MZ100 inlays than for the direct composite restorations. Although use of an GI/RMGI base layer did not increase fatigue resistance, it did decrease the shrinkage-induced enamel crack propensity compare to direct resin composite.
Objectives: The purpose of this study was to test a glass film as a zirconia surface modified agent to improve Y-TZP ceramic adhesion to resin cement.

Methods: The glass (BG) was obtained from a stable colloidal suspension (60SiO$_2$-36CaO-4P$_2$O$_5$ in ethylene glycol). Twelve zirconia blocks (5 x 5 x 6mm) were obtained from larger pre-sintered zirconia blocks (YZ – VITA Zahnfabrik). After sinterization, each block was submitted to one of the following treatments: G1 – Al$_2$O$_3$ sandblasting (SB) + silane (Si); G2 – Zirconia Bond (Kulzer); G3 – SB + Zirconia Bond; G4 – Rocatec (3M ESPE) + Si; G5 – BG + firing cycle (800°C) + Si. Resin blocks (Z350 – 3M ESPE) with the same dimensions of the ceramic specimens were produced, sandblasted and silanized. They were cemented to the ceramic blocks with RelyX™ U100 Self-Adhesive Universal Resin Cement (3M ESPE). Cemented specimens were sectioned to obtain sticks with a cross section of 1.0 x 1.0mm and then were submitted to microtensile bond strength test at a crosshead speed of 1 mm/minute. Microtensile bond strength (μTBS) means (MPa) were subjected to analysis of variance (ANOVA) and a Tukey’s post-hoc test (p < 0.05).

Results: Means and standard deviations for groups were: G1 – 12.7 ± 2.0c; G2 – 16.8 ± 4.1bc; G3 – 32.7± 8.9a; G4 – 29.6 ± 7.6ab; G5 – 24.8 ± 4.33abc.

Conclusions: Addition of a glass film to YTZP surface presented bond strength to a resin cement results as effective as Rocatec and sandblasting followed by Zirconia Bond.

This abstract is based on research that was funded entirely or partially by an outside source: Capes

3M ESPE Summary

Aim of Study: To investigate the bond strength of RelyX U100 Self-Adhesive Universal Resin Cement to zirconia after different surface pre-treatments.

Summary of Results: Rocatec surface pre-treatment proved to be as effective as adding a glass film to the zirconia for bonding purposes or as using a zirconia primer after sandblasting.
**Sinfony™ Indirect Lab Composite**

**Color Stability of Indirect Composite Resins**


**Objectives:** Some chemical components from drinking solutions, mouthwashes and whitening agents may change the color of indirect composite resins. Information about the effect of such solutions on the color change of this material is scarce. The purpose of this study was to investigate the effect of different solutions on the color change (E) of indirect composite resins.

**Methods:** Five different brands of indirect composite resins were assessed: Adoro, Resilab, Cristobal, Sinfony and Epicord. Samples were submitted to eleven different types of solutions (n = 10): drinking solutions (coke, wine, coffee and orange juice), mouthwashes (Listerine, Oral-B, Plax, Periogard) and dental whitening agents (16% carbamide peroxide, 7.5% and 38% hydrogen peroxides) and artificial saliva (control). The specimens’ color were measured with a spectrophotometer, using the CIE L*a*b* system, at baseline and after 7, 14 and 21 days of immersion in drinking solutions; after 12, 24, 36 and 60 hours of immersion in mouthwashes; and after 7 and 14 days of immersion in whitening agents. E ≤ 3.3 was considered clinically acceptable. Data were evaluated by 3-way repeated-measures ANOVA and Tukey HSD test (= .05).

**Results:** Cristobol and Adoro resins exhibited the highest ΔE values; these values were significantly higher than the values obtained for the other brands (P < .05). The ΔE values of Adoro resin were significantly changed by the wine and coffee solutions among the measurement periods. Cristobol and Sinfony resins exhibited greater ΔE values after immersion in Listerine, with significant difference (P < .05) when compared with the control group. Additionally, there was significant difference (P < .05) of the E values for the Cristobol resin after immersion in 7.5% hydrogen compared to the control group.

**Conclusions:** Although all solutions promoted color alteration of the indirect resins, the ΔE values are within acceptable clinical limits.

This abstract is based on research that was funded entirely or partially by an outside source: FAPESP (grant number 2010/17743-8) FUNDUNESP (grant number 57/11-DFP).

**3M ESPE Summary**

**Aim of Study:** To measure the stain resistance and color stability of the indirect composite resins Adoro, Resilab, Cristobal and Sinfony.

**Summary of Results:** Over all Sinfony composite exhibited significantly lower color change values ΔE as compared to Adoro and Cristobal.
3M™ ESPE™ MDI Mini Dental Implants

Tissue Responses to Two Mini Dental Implants in Miniature Swine

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Objectives: To evaluate and compare histology and osseointegration of MDI Mini Dental Implants (3M ESPE, St. Paul, MN) and MDL Mini Dental Implants (Intra-Lock International, Boca Raton, FL).

Methods: Premolars of four miniature swine were extracted. After 3-month healing, the implants were inserted following manufacturers’ instructions and pertinent ISO guidelines. Each animal received five MDI implants of 02.4mm and 01.8mm and three MDL of 02.5mm and 02.0mm. All implants were 10mm in length. Two pairs of randomly determined swine were sacrificed at 3 and 6 months, respectively. The implant sites were inspected visually; and the samples with implants were harvested and randomly assigned to histopathological or histomorphometrical evaluation.

Results: All animals grew normally and no signs of post-operative discomfort or abnormal behavior were observed in any of the animals throughout the experimental period. Visual examination of implant areas found 4 and 11 mini implants lost at 3 and 6 months, respectively. All remaining mini implants showed no mobility and their peri-implant gingiva appeared healthy. The radiographs also appeared to be normal for all mini implant sites. Tissue responses to implants were minimal, with most at mild to moderate levels and comparable between the MDI and MDL mini implants, regardless of their size, as examined using the Fisher Exact Test at = 0.05. Histomorphometrical evaluation found 100% bone contact to the implant surface regardless of time of sampling, indicating excellent osseointegration of both MDI and MDL Mini Dental Implants.

Conclusions: Under conditions of the present study, overall swine tissue responses to MDI and MDL Mini Dental Implants were minimal and comparable; both the MDI and MDL Mini Dental Implants are capable of achieving significant osseointegration after 6 months. The study was supported by a grant from 3M ESPE.

This abstract is based on research that was funded entirely or partially by an outside source: 3M ESPE

Keywords: Biocompatibility, Histology — Ultrastructure, Oral implantology, Osseointegration and Toxicology
3M™ ESPE™ MDI Mini Dental Implants

Retention of Mini Dental Implant Retained Overdentures

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Objectives: To measure the retentive capabilities of mandibular overdentures when retained by mini dental implants (MDI). The number and position of MDIs was varied.

Methods: An acrylic model representing an edentulous mandibular arch and a denture were fabricated in high impact denture acrylic resin (Lucitone 199). Five mini implants were placed in the anterior region of the mandibular acrylic arch and associated housings were picked up into the mandibular denture using acrylic resin. The denture was then attached, via acrylic resin, to an aluminum plate with a perpendicular bolt for connection to the cross head of an Instron universal testing machine. The denture was pulled in a direction perpendicular to the arch at a rate of 50mm/minute. The maximum load to dislodge was recorded in Newtons. Seven combinations of position and number of implants were tested by placing and removing the O-rings. The test was repeated twenty times to access wear of the O-rings for each of the seven combinations of MDIs. Data was analyzed via ANOVA and Tukey-Kramer HSD tests (Jump Software).

Results: The mean force (and standard deviation) in Newtons for dislodgement for the seven combinations were as follows: 1 MDI midline = 4.13 (0.15), 2 MDIs narrow = 7.84 (0.24), 2 MDIs wide = 13.49 (1.26), 3 MDIs narrow = 18.50 (0.35), 3 MDIs wide = 19.54 (0.21), 4 MDIs = 24.10 (0.33), 5 MDIs = 26.86 (1.23). Each combination was statistically significantly different from all other combinations. Repeated testing, 20 times, did not result in a loss of retention.

Conclusions: Mini dental implant overdentures are an acceptable alternative when traditional implants are not indicated. This study recommends four mandibular overdenture mini dental implants, as five was not a clinically significantly increase in retention. Position affected the amount of retention only when using two mini dental implants, in which case a wide orientation was more retentive.

Keywords: Implants and Prosthodontics

3M ESPE Summary

Aim of Study: To measure the retentive capabilities of mandibular overdentures when retained by mini dental implants (MDI). The number and position of MDIs was varied.

Summary of Results: Mini dental implant overdentures are an acceptable alternative when traditional implants are not indicated. This study recommends four mandibular overdenture mini dental implants, as five was not a clinically significantly increase in retention. Position affected the amount of retention only when using two mini dental implants, in which case a wide orientation was more retentive.
3M™ ESPE™ MDI Mini Dental Implants

Retentive Characteristics of Narrow-Diameter Implant-Retained Overdentures after Fatigue Loading

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Objectives: To compare retentive and morphological changes of five stud attachment systems for implant-retained overdentures after repeated insertion (7,200 cycles) and 78N loading in vitro onto implant abutments.

Methods: Five mechanical (Pink Liner, Zest Locator; Metal Housing and Micro Metal Housing, 3M ESPE; Micro Metal Housing, Intra-Lock; and Silicone Liner, Dentatus USA) attachments were embedded in overdenture base (n = 10). Overdentures with Locator attachments were tested on acrylic models with two parallel conventional implants (4.3 × 9mm). The O-ring attachments and silicone liner were tested on models with four parallel narrow-diameter implants. Specimens were loaded sinusoidally from zero to 78N in a coil cycler fatigue machine (Proto-Tech, Portland, OR) at 2Hz for 7,200 cycles in a 37°C water bath. Vertical tensile dislodging forces were recorded at a cross-head speed of 50mm/minute after repeated insertions (baseline, 50, 500, 900, 1,800, 3,600, 5,400 and 7,200 cycles). Statistical analysis: ANOVA and Tukey HSD post-hoc tests at the 95% confidence level.

Results: The peak load-to-dislodgement force ranged from 6.4 (0.5) N to 19.0 (2.9) N after 7,200 cycles of repeated insertion. The retention values of the MDI Micro Metal Housing and Locator Pink Liner attachments were significantly higher than other groups after 7,200 cycles (P < .01). The Locator Pink Liner group, Silicone Liner group and MDI Micro Metal Housing with O-ring attachment showed changes in retentive force values of 82.8%, 31.5% and 18.1% respectively after 7,200 cycles fatigue loading. Microscopic examination of the specimens revealed wear and degradation consistent with the loss of retention.

Conclusions: The retention force values of O-ring attachments with four narrow-diameter implant systems were equivalent to the Locator Pink Liner with two regular implants after 7,200 cycles fatigue loading.

Keywords: Biomechanics, Loading, Oral implantology, Prosthodontics and Wear

3M ESPE Summary

Aim of Study: To compare retentive and morphological changes of five stud attachment systems (including the 3M ESPE MDI housing for o-ball attachments) for implant-retained overdentures after repeated insertion (7,200 cycles) and 78N loading in vitro onto implant abutments.

Summary of Results: The retention force values of O-ring attachments with four narrow-diameter implant systems were equivalent to the Locator Pink Liner with two regular implants after 7,200 cycles fatigue loading.
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C. DEFURIA, M. HARSONO, J. TOWERS, R.D. PERRY and G. KUGEL, Tufts University, Boston, MA

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Volumetric Polymerization Shrinkage Characteristics of Provisional Crown & Bridge Materials
A. TIBA, R.J. GEARY and J.C. KUEHNE, American Dental Association, Chicago, IL

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New Provisional Restorative Containing Resins with No Bisphenol A (BPA) Components
N. ARALIS, Danville Materials, San Ramon, CA and C. ANGELETAKIS, Proteas Technologies, Orange, CA

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IADR 2012  Abstract #1025
Bond Strength of Self-Adhesive Resin Cements to Zirconia
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IADR 2012  Abstract #1342
Shear Bond Strength of Resin Cements to Different Composite Resins
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AADR 2012  Abstract #219
Resin Cements Bonded on Different Treated Non-Precious and Semi-Precious Metal-Alloys
A.J. ST-GEORGES, L. NASERI, H. CIABURRO and P. ROMPRÉ, Restorative dentistry, Université de Montreal, Montreal, QC, Canada

AADR 2012  Abstract #220
Bond Strength of Self-Adhesive Cement to Bis-Acryl Composite and Acrylate-Polymer
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AADR 2012 Abstract #238
Performance of Conventional vs. Proximal-Winged CAD/CAM Laminates: Fatigue and 3D-FEA
E. ELDWAKHLY, Cairo university, Cairo, Egypt, H. SALLAM, Cairo university, Alexandria, Egypt and A. ELRAGI, Qassim University, KSA, Qassim, Saudi Arabia

AADR 2012 Abstract #242
Shear Bond Strength of Auto-Mixing Self-Adhesive Resin Cements to Zirconia
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AADR 2012 Abstract #250
Curing Condition Affects Monomer Conversion of Self-Adhesive Resin Cements
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Bond Strength Comparisons of Six Cements to Premise Indirect Composite
C.J. ELLIOTT, G. FREY and J. ONTIVEROS, Biomaterials, University of Texas — Houston/Health Science Center, Houston, TX

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SEM/TEM Analysis of Self-Adhesive Cements: Pulpal Pressure and IDS
A.F. REIS, V.B. SANTANA, R.S. ALEXANDRE and J.A. RODRIGUES, Department of Operative Dentistry, Guarulhos University, Guarulhos, SP, Brazil

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Tensile Bond Strength of Different Luting Agents at the Cement-Restoration-Interface
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Microleakage Evaluation of All-Ceramic Crowns Bonded Above/Below the CEJ
M. TSAO, S. JOHN, E. DOHERTY, M. FINKELMAN, M. HARSONO and G. KUGEL, Tufts University, Boston, MA

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Shear-Bond-Strength of Self-Adhesive Resin Cements (Lithium Disilicate/Zirconia) to Dentin
N. FREDAYA, D. NILL, R.D. PERRY, J. TOWERS, G. KUGEL and M. HARSONO, Tufts University, Boston, MA

AADR 2012 Abstract #1007
Evaluation of Bonding Stability Between Treated Y-TZP and Resin Cements
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AADR 2012  Abstract #1012
Effect of Primers on Bonding of Resin Cements to Ceramics
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Effect of a Desensitizer on the Luting Agents/Dentin Bond Strength
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Crown Retention After Long-Term Specimen Aging for Self-Adhesive Modified-Resin Cements
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Zirconia Ceramic Resin Cement Bonding
J.L. ROMÁN RODRÍGUEZ, A. FONS FONT, II, M. GRANELL RUÍZ, R. AGUSTÍN PANADERO, Sr., C. LABAIG RUEDA and M.F. SOLÁ RUÍZ, Department of Buccofacial Prosthetics, Faculty of Medicine and Dentistry, University of Valencia. Spain, Valencia, Spain

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Bonding of Fiber Posts with Different Cements: Aging Influence

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Influence of the Zirconia Core-Design on the In-Vitro Failure Performance
C. LETSCH1, M. BEHR1, C. KOLBECK2, G. HANDEL1 and M. ROSENTRITT1, 1Department of Prosthetic Dentistry, Regensburg University Medical Center, Regensburg, Germany, 2Dept. of Prosthetic Dentistry, Regensburg University Medical Center, Regensburg, Germany

CED–IADR 2011  Abstract #374
Influence of Mixing Method on the Porosity of Resin Cements
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CED–IADR 2011  Abstract #432
Effects of Dycal on Shear Bond Strength of Resin Cements
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CED–IADR 2011  Abstract #437
Efficiency of Bonding Agent on Dentin for Self-Adhesive Resin Cements
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Post Retention Using Self-Etch and Conventional Techniques
C.H. PAMEIJER, Reconstructive Sciences, University of Connecticut, Simsbury, CT and R. TUTTLE, Ultradent Products Inc, South Jordan, UT

IADR 2012  Abstract #1007
Bond Strength of Resin Cements to Dentin Using Resin Coating
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The Effect of Cement Polymerization on the Intra-Root Bond Strength
C. HIGASHI, M.D. MICHEL, A.D. LOGUERCIO, O.M.M. GOMES and J.C. GOMES, Secretaria do Programa de Pós-Graduação Stricto Sensu em Odontologia, Universidade Estadual De Ponta Grossa, Ponta Grossa, Brazil

IADR 2012  Abstract #1031
Inflammation and Matrix Metalloproteinases are Differentially Modulated by Luting Agents
A.M. QUEIROZ, F.W. PAULA-SILVA, P. NELSON-FILHO and L.A.B. SILVA, Pediatric Clinics, Preventive and Social Dentistry, University of Sao Paulo, Ribeirao Preto, Brazil

IADR 2012  Abstract #1335
Mechanical Behavior of Adhesive Interface Between Glass Fiber-Post and Dentin
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IADR 2012  Abstract #1340
Pulpal Pressure Effects on µTBS/Nanoleakage of Cements After 12 Months
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IADR 2012  Abstract #1406  
**Influence of Activation Mode in the Properties of Self-adhesive Cements**  
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IADR 2012  Abstract #2002  
**Bond Strength of Resin Cements to Dry and Moist Dentin**  
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IADR 2012  Abstract #2309  
**Adaptation and Micro-Leakage of Crowns Cemented with Self-Adhesive Resin Cements**  
D.E.S. AWAD, Faculty of Dentistry, Suez Canal University, Cairo, Egypt and O. ATTA, Suez Canal University, Ismailia, Egypt

IADR 2012  Abstract #2713  
**Clinical Outcome of Lithium Disilicate Endocrowns — A 3-Year Follow-Up**  
B. ZIMMERLI, D. DIROCCO, M. GYGAX, M. STRUB and A. LUSSI, Preventive, Restorative and Pediatric Dentistry, University of Bern, Bern, Switzerland

IADR 2012  Abstract #2965  
**Evaluation of Resin-Cements Marginal Adaptation to Class-V Cavity Using SS-OCT**  
P. MAKISHI¹, Y. SHIMADA¹, A. SADR¹, T.A. BAKHSH², I. HARIRI², J. TAGAMI³ and Y. SUMI³, ¹Dept. of Cariology and Operative Dentistry, Tokyo Medical and Dental University, Tokyo, Japan, ²Cariology and Operative Dentistry, Department of Restorative Sciences, Global COE, Tokyo Medical & Dental University, Tokyo, Japan, ³National Center for Geriatrics and Gerontology, Aichi, Japan

IADR 2012  Abstract #166460  
**Bond Strength of Fiber Posts Cemented with Different Resin-Based Cements**  
S. HAAS¹, G. DIAZ², L. OLIVEIRA², T.C. SAYIN³, P. HARDIGAN¹ and H. LIPPMAN¹, ¹Cariology and Restorative Dentistry, Nova Southeastern University, Parkland, FL, ²Prosthodontics, Nova Southeastern University, Parkland, FL, ³Endodontics, Nova Southeastern University, Fort Lauderdale, FL, ¹Director of the Center for Statistical Consulting, Nova Southeastern University, Parkland, FL

RelyX™ Unicem Self-Adhesive Resin Cement and RelyX™ Fiber Post

CED

CED–IADR 2011  Abstract #245  
**Influence of Ferrule and Post Lengths on Endodontically Treated Teeth**  
D. KLEIN, T. GALOSI, F. BEUER and D. EDELHOFF, Prosthodontics, Ludwig-Maximilians-Universität München, Munich, Germany

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RelyX™ Unicem Self-Adhesive Resin Cement and RelyX™ Fiber Post (cont.)

CED—IADR 2011  Abstract #247
Microleakage of Two Fiber Posts Luted with Simplified Adhesive Approaches
U. ERDEMIR1, H. SAR SANC trollingEscribL1, E. YILDIZ2, 1Dept. of Operative Dentistry, University of Istanbul, Istanbul, Turkey, 2Department of Biostatistics and Medical Informatics, University of Istanbul, Istanbul, Turkey

CED—IADR 2011  Abstract #250
Bond Strengths of Self-Adhesive Resin Cements for Luting Fiber Posts
K. BITTER, Department of Operative Dentistry and Periodontology, Charité — Universitätsmedizin Berlin, Berlin, Germany, G. STERZENBACH, Dept. of Prosthodontics, Geriatric Dentistry and Craniomandibular Disorders, Charité — University of Berlin, Berlin, Germany, A. MICIC, Department of Operative Dentistry and Periodontology, Charite — Universitätsmedizin Berlin, Berlin, Germany, L. BRESCHI, Department of Biomedicine, University of Trieste, Trieste, Italy and M. TASCHNER, Dental Clinic 1, University of Erlangen, Erlangen, Germany

IADR
IADR 2012  Abstract #165969
Long-Term Stability of Silorane-Based Composite Resin Used as Core Build-Up
B. SARTORI1, B. MONTEIRO1, L. VASCONCELOS1, L. SABROSA2 and C.E. SABROSA1, 1Universidade do Estado do Rio de Janeiro, Rio de Janeiro, Brazil, 2Clinica Odontológica Dr. Sabrosa, Rio de Janeiro, Brazil

RelyX™ ARC Adhesive Resin Cement

AADR
AADR 2012  Abstract #250
Curing Condition Affects Monomer Conversion of Self-Adhesive Resin Cements
T.R. AGUIAR1, M. OLIVEIRA2, C.A.G. ARRAIS2 and M. GIANNINI1, 1Restorative Dentistry, State University of Campinas — Piracicaba Dental School, Piracicaba-SP, Brazil, 2Operative Dentistry, University of Guarulhos, Guarulhos, Brazil

AADR 2012  Abstract #465
SEM/TEM Analysis of Self-Adhesive Cements: Pulpal Pressure and IDS
A.F. REIS, V.B. SANTANA, R.S. ALEXANDRE and J.A. RODRIGUES, Department of Operative Dentistry, Guarulhos University, Guarulhos, SP, Brazil

AADR 2012  Abstract #1007
Evaluation of Bonding Stability Between Treated Y-TZP and Resin Cements
L. MIRAGAYA1, E. SILVA1, S.M. MORGANO2 and C. SABROSA3, 1UFF, Rio de Janeiro, Brazil, 2Boston University, Boston, MA, 3Universidade Do Estado do Rio de Janeiro, Rio de Janeiro, Brazil

AADR 2012  Abstract #1017
Effect of a Desensitizer on the Luting Agents/Dentin Bond Strength
E.C. TEIXEIRA, Comprehensive Dentistry, University of Texas at San Antonio, San Antonio, TX and N. RANEY, University of Texas at San Antonio, San Antonio, TX

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RelyX™ ARC Adhesive Resin Cement (cont.)

AADR 2012  Abstract #1285
Risks of Ceramic and Cement Failure on Posterior Onlay Restoration
D. KOIS1, V. ISVILANONDA2, Y. CHAYABUTR1 and J.C. KOIS1, 1Kois Center Research, Seattle, WA, 2Mechanical Engineer, University of Washington, Seattle, WA

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IADR 2012  Abstract #1008
Chlorhexidine on Adhesion of Fiber-Post Using Resin-Cement or Resin-Modified-Glass-Ionomer Cement
D.F.G. ARAÚJO1, T. PINTO2, L.M. SILVA3, R.M. MAENOSONO1, O. BIM JÚNIOR1, S. ISHIKIRIAMA4 and L. WANG2, 1Bauru School of Dentistry, University of São Paulo, Bauru, Brazil, 2Bauru School of Dentistry, University of São Paulo, Bauru, Brazil, 3Federal University of Amazonas, Manaus, Amazonas, Brazil, 4Restorative Dentistry, Endodontics and Dental Materials, Bauru Dental School, Bauru, Brazil, 5Operative Dentistry, Bauru School of Dentistry — University of São Paulo, Bauru, SP, Brazil

IADR 2012  Abstract #1325
Different Adhesion Approach on Bond-Strength of Fiber Posts to Dentin
S. PAVAN, Adamantina School of Dentistry, Adamantina-SP, Brazil, T.Y.U. SUZUKI, Dental Materials and prosthodontics, Sao Paulo State University, Aracatuba, Brazil, A.L.F. BRISO, Department of Restorative Dentistry, Operative Dentistry Division, Araçatuba Dental School, Araçatuba, Brazil, W.G. ASSUNÇÃO, Dental Materials and Prosthodontics, Univ. Estadual Paulista (UNESP), Aracatuba, Brazil, J.E. GOMES-FILHO, Odontologia Restauradora, Universidade Est. Paulista Julio Mesquita, Araçatuba, Brazil and P.H. DOS SANTOS, Dept. of Dental Materials & Prosthodontics, Universidade Estadual Paulista, Aracatuba SP, Brazil

IADR 2012  Abstract #1332
FRC-Dentin Adhesion: Effect of Resin-Cements and FRC Surface Conditioning
J.L. POZZOBON1, C.C. DRUCK1, C. BERGOLI2 and L.F. VALANDRO3, 1Universidade Federal De Santa Maria, Santa Maria, Brazil, 2Departament of Dental Materials and Prosthodontics, Univ. Estad. Paulista ‘Júlio Mesquita Filho’ (UNESP), São José dos Campos, Brazil, 3Restorative Dentistry, Universidade Federal De Santa Maria, Santa Maria, Brazil

IADR 2012  Abstract #1333
Influence of Chemical Cleaning Agents on Adhesion to Glass-Fiber Posts
A.P.R. GONÇALVES1, A.S. OLIVEIRA1, P.S. JARDIM2 and R.R. MORAES3, 1Universidade Federal de Pelotas, Pelotas, Brazil, 2Univ. Federal De Pelotas, Pelotas, Brazil

IADR 2012  Abstract #1405
Evaluation of the Knoop Microhardness of Different Resins Luting Cements
M.P.D.C. ROCHA SR.1, T.P. MAIA2, M.H. VILHENA DA SILVA2, S.C. LORETTO2, A.C. ARANHA1 and C.M. SILVA2, 1Protese, University of Sao Paulo-USP, Belem, Brazil, 2Protese, University of Pará, Belem, Brazil

IADR 2012  Abstract #1713
Effect of Post Composition on Hardness of Different Resin Cements
M.K. TAKAHASHI, G.A. KIRSTEN, R.T. BRUM, S. VIEIRA, R.N. RACHED, R.F. MAZUR and E.M. SOUZA, Graduation Program in Dentistry, Pontifical Catholic University of Paraná, Curitiba, Brazil

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RelyX™ ARC Adhesive Resin Cement (cont.)

IADR 2012  Abstract #1714
Resin Cement: Influence of Polymerization Protocols in Different Root Depths

IADR 2012  Abstract #1732
Cohesive Strength Properties of Dual Resin Cements
A.G. MELLO1, A.P.G.D.O. FRANCO2, R.G. COSTA3, S. VIEIRA4, M.A.B. ORTELLADO1, G.M. CORRER3, M.P. LEÃO4 and M.J. FRAXINO BINDO1, 1Federal University of Paraná, Curitiba, Brazil, 2Masters of Science Program in Clinical Dentistry, Positivo University, Curitiba, Brazil, 3Federal Institute for Education, Science and Technology of Paraná, Curitiba-PR, Brazil, 4Dentistry, Pontifical Catholic University of Paraná, Curitiba, Brazil, 4Masters of Science Program in Clinical Dentistry, Positivo University, Curitiba, Brazil, Brazil

IADR 2012  Abstract #1742
Evaluation of Mechanical Properties of Dual Cements in Different Root-Thirds
R.T. QUEIROZ1, A.P.G.D.O. FRANCO2, R.G. COSTA3, S. VIEIRA4, E. MORAIS5, M.P. LEÃO6, N. ULBRICH1 and M.J.F. BINDO1, 1Federal University of Paraná, Curitiba, Brazil, 2Masters of Science Program in Clinical Dentistry, Positivo University, Curitiba, Brazil, 3Federal Institute for Education, Science and Technology of Paraná, Curitiba-PR, Brazil, 4Dentistry, Pontifical Catholic University of Paraná, Curitiba, Brazil, 5Positivo University, Curitiba-PR, Brazil, 6Masters of Science Program in Clinical Dentistry, Positivo University, Curitiba, Brazil, Brazil

IADR 2012  Abstract #1970
Bond Strength of Resin Cement to Sealed Dentin Following Impression
P. MIKLOS, Lackland Air Force Base, Lackland AFB, TX and E.C. TEIXEIRA, Comprehensive Dentistry, University of Texas — San Antonio/Health Science Ctr, San Antonio, TX

IADR 2012  Abstract #1981
Influence of Filling Materials and Cleaning Agents on Bond Strength
A.S. IWAMOTO1, É. BANZI2, V. BENETELLO1, R. PUPPIN-RONTANI3 and F.M. PASCON4, 1Piracicaba Dental School — University of Campinas, Piracicaba, Brazil, 2Pediatric Dentistry, Piracicaba Dental School — University of Campinas, Piracicaba, Brazil, 3Pediatric Dentistry, State University of Campinas, Piracicaba-SP, Brazil, 4Pediatric Dentistry, University of Campinas, Piracicaba-SP, Brazil

IADR 2012  Abstract #1992
Bond Strength of Resin Cements to Zirconia Ceramic Using Primers
A. STEFANI SR., Prosthetic Dentistry, Sao Leopoldo Mandic, Sao Paulo, Brazil, R.B. BRITO SR., Prosthetic Dentistry, Sao Leopoldo Mandic, Campinas, Brazil, S. KINA SR., Prosthetic Dentistry, Sao Leopoldo Mandic, Maringa, Brazil, O.S. ANDRADE SR., Prosthetic Dentistry, Senac, Sao Paulo, Brazil, G.M.B. AMBROSANO, Social Dentistry, State University of Campinas, Piracicaba-SP, Brazil, A. CARVALHO, Dental Materials, Piracicaba Dental School/Unicamp, Piracicaba, Brazil and M. GIANNINI, Restorative Dentistry, State University of Campinas, Piracicaba-SP, Brazil

IADR 2012  Abstract #1993
Durability of Resin Bond Strength to Ceramic After Surface Treatments
O.I. NETO, Prosthetic Dentistry, Severino Sombra University, Paracambi, RJ, Brazil, F.D.R. GOYATA, Prosthetic Dentistry, Severino Sombra University, Resende, Brazil, F.V.D. LANDA, Prosthetic Dentistry, Severino Sombra University, Juiz De Fora, Brazil and L. CUNHA, Restorative Dentistry, University of Alagoas, Maceio, Brazil

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RelyX™ ARC Adhesive Resin Cement (cont.)

IADR 2012  Abstract #1997
**Microshear Bond Strength of Resin Materials to Ceramic**
G.R. BASSO, G. RENATA and V. LUIZ CLÓVIS CARDOSO, Odontologia — disciplina de Dentística, Universidade Federal De Santa Catarina, Nova Alvorada, Brazil

IADR 2012  Abstract #1999
**Effect Of Silanization Methods on the Bond Strength of IPS e.max Press Ceramic**
L.M. PEIXOTO, Universidade Do Estado do Rio de Janeiro, Vitoria, Brazil, C.B. SANTOS-DAROZ, Dental Prosthesis, Universidade Federal do Espírito Santo, Vitoria ES, Brazil, G.M. MARCHI, Restorative Dentistry, Faculdade de Odontologia de Piracicaba, Piracicaba, Brazil, E. BATITUCCI, Universidade Federal do Espírito Santo, Vitoria ES, Brazil and H. SAMPAIO, Universidade Do Estado do Rio de Janeiro, Rio de Janeiro, Brazil

IADR 2012  Abstract #2000
**Porcelain-Dentin Adhesion: Effect of Mechanical-Cycling and Luting Protocols**
C.C. DRUCK1, M.P. KONZEN1, E.P. PROCHNOW1, C. BERGOLI2, M. AMARAL3 and L.F. VALANDRO4, 1Universidade Federal De Santa Maria, Santa Maria, Brazil, 2Department of Dental Materials and Prosthodontics, Univ. Estad. Paulista ‘Júlio Mesquita Filho’ (UNESP), São José dos Campos, Brazil, 3Dental Material and prosthesis, Universidade Est. Paulista Julio Mesquita, São José dos Campos, Brazil, 4Restorative Dentistry, Universidade Federal De Santa Maria, Santa Maria, Brazil

IADR 2012  Abstract #2318
**Viability of MicroCT in Access Intraradicular Cementation Gaps**
A.P. PEDREIRA1, A. SOUZA1, S. CHAVES2, P.N.R. PEREIRA1, L.A. HILGERT and F.C.P. GARCIA1, 1School of Dentistry, University of Brasilia, Brasilia, Brazil, 2University of Brasilia, Brasilia, Brazil

IADR 2012  Abstract #2701
**Isothermal Curing and Biaxial Flexural Strength of Dual-Cured Resin Cements**
M.F. DE GOES, Restorative Dentistry, Piracicaba Dental School — University of Campinas, Piracicaba-SP, Brazil, C. AZEVEDO, Campinas State University, Piracicaba, Brazil and F. RUEGGEBERG, Dental Materials, Georgia Health Sciences University, Augusta, GA

IADR 2012  Abstract #2745
**Diametral and Compressive Tensile Strength of Composite Resin Cements**
A.F. CARTAGENA1, I. LUQUE2, V. HASS2 and N.H. CAMPANHA3, 1Universidade Estadual De Ponta Grossa, Ponta Grossa, Brazil, 2UEPG, Ponta Grossa, Brazil, 3Dentistry, Universidade Estadual de Ponta Grossa, Ponta Grossa, Brazil

IADR 2012  Abstract #3051
**Bond Strengths of New “Universal” Dental Adhesives**
L. CHEN1, Y. AHN1, P.L. CHILD2, D. BROWN2 and B.I. SUH2, 1Research and Development, Bisco Inc, Schaumburg, IL, 2Bisco Inc, Schaumburg, IL

IADR 2012  Abstract #166199
**Effect on Bond Strengths of Different Adhesive System Over IDS**
N. ORELLANA1, J. COLINA1, H. ROSALES1, V. SETIEN1, R. RAMIREZ2, M. ROIG2 and L. GINER3, 1Facultad de Odontología, Universidad de Los Andes, Merida, Merida, Venezuela, 2Restorative Dentistry, Universitat Internacional de Catalunya, Barcelona, Spain

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AADR 2012  Abstract #1015
Effect of Mixing Methods on the Bonding Strength of GIC
R. AKATSUKA, S. FUKUSHIMA and K. SASAKI, Prosthetic Dentistry, Tohoku University Graduate School of Dentistry, Sendai, Japan

AADR 2012  Abstract #1016
Effect of Mixing Methods on the Physical Properties of GIC
S. FUKUSHIMA1, R. AKATSUKA2 and K. SASAKI1, 1Prosthetic Dentistry, Tohoku University Graduate School of Dentistry, Sendai, Japan, 2Tohoku University Graduate School of Dentistry, Sendai, Japan

AADR 2012  Abstract #24
Fracture Strength of All-Ceramic Restorations After Fatigue Loading
B. BALADHANDAYUTHAM1, P. BECK2, M.S. LITAKER3, D. CAKIR2 and J. BURGESS2, 1School of Dentistry, University of Alabama at Birmingham, Birmingham, AL, 2University of Alabama at Birmingham, Birmingham, AL, 3Dept. of General Dental Sciences, University of Alabama at Birmingham, Birmingham, AL

RelyX™ Fiber Post

CED

CED–IADR 2011  Abstract #371
Ferrule-Effect and Fiber-Post Placement: Influence on Fatigue and Fracture Resistance
F. ZICARI1, B. VAN MEERBEEK2, R. SCOTTI3 and I. NAERT1, 1Dept. of Prosthetic Dentistry, K.U.Leuven, Leuven, Belgium, 2Leuven BIOMAT Research Cluster, Department of Conservative Dentistry, Catholic University of Leuven, Leuven, Belgium, 3Prosthetic Dentistry, University of Bologna, Bologna, Italy

Ketac™ Cem Radiopaque Permanent Glass Ionomer Luting Cement

IADR

IADR 2012  Abstract #2702
Long-Term Evaluation of Mechanical Properties of Glass Ionomer with Chlorhexidine
C. BITTENCOURT, M. FARRET, E.M.S.D. LIMA, L. OSÓRIO and E. MOTA, Ortodontia, Pontifícia Universidade Católica do Rio Grande do Sul, Porto Alegre, Brazil

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RelyX™ Veneer Cement

CED

CED–IADR 2011  Abstract #126
Bond Strength of Porcelain Laminate Veneers to Dental Hard Tissues
E. OZTURK, School of Dentistry, Hacettepe University, Ankara, Turkey, S. BOLAY, Dental College, Ankara, Turkey, R. HICKEL, Dept. of Rest Dent, Period & Pedodont, University of Munich, Munich, Germany and N. ILIE, Department of Restorative Dentistry and Periodontology, Ludwig-Maximilians University, Munich, Germany

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IADR 2012  Abstract #2700
Glass-Ceramics Opacity Influence on Microhardness and Conversion of Light-Cured Materials
A.Y. FURUSE, D.H. GLIR, P.A.M. CALGARO, L.K.V. RODRIGUES, P. RUNNACLES and C.C. GONZAGA, Masters of Science Program in Clinical Dentistry, Positivo University, Curitiba, Brazil

IADR 2012  Abstract #2695
Influence of Different Thickness of Ceramics Veneers at Conversion Degree
P. RUNNACLES1, A.Y. FURUSE1, C.C. GONZAGA1, G. BERGER SR.2, G.M.C. NOLASCO1, P.A.M. CALGARO1 and E.A.G. BETIOL3, 1Masters of Science Program in Clinical Dentistry, Positivo University, Curitiba, Brazil, 2Department of Restorative Dentistry, Federal University of Parana, Curitiba, Brazil, 3Universidade Federal do Paraná, Curitiba, Brazil

IADR 2012  Abstract #2698
Effect of Photoactivation Through Different Ceramics on Two Resin Cements
P.A.M. CALGARO, P. RUNNACLES, G.M. CORRER, A.Y. FURUSE and C.C. GONZAGA, Masters of Science Program in Clinical Dentistry, Positivo University, Curitiba, Brazil

RelyX™ U200 Self-Adhesive Resin Cement

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CED–IADR 2011  Abstract #190
In-Vitro Results on Self-Adhesive Resin Cements
B. BALDEA1, G. FURTOS2, M. ANTAL3, D. BRATU1, K. NAGY4 and L. NICA1, 1Faculty of Dental Medicine, Victor Babes University of Medicine and Pharmacy, Timisoara, Romania, 2Raluca Ripan Institute of Research in Chemistry, Babes-Bolyai University, Cluj-Napoca, Romania, 3Department of Operative Dentistry and Endodontics, University of Szeged Faculty of Dentistry, Szeged, Hungary, 4Department of Oral Surgery, University of Szeged Faculty of Dentistry, Szeged, Hungary

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RelyX™ U100 Self-Adhesive Universal Resin Cement

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AADR 2012  Abstract #997
Shear Bond Strength of Self-Adhesive Cements to Ceramics
G.R. BASSO¹, S. MONTEIRO JR² and M.A.C. DE ANDRADA³, ¹Odontologia — Disciplina de Dentística, Universidade Federal De Santa Catarina, Nova Alvorada, Brazil, ²Odontologia — Disciplina de Dentística, Universidade Federal De Santa Catarina, Florianópolis, Brazil

CED

CED–IADR 2012  Abstract #434
Dentin Moisture Effect on Microleakage of Self Adhesive Resin Cements
W. TORNOR, Prosthodontics, Chulalongkorn University, Bangkok, Thailand and N. THAMRONGANANSKUL, Chulalongkorn University, Bangkok, Thailand

CED–IADR 2011  Abstract #435
Storage Temperature Effect on Tensile Bond Strength of Resin Cements
K. SANSANEEYAWAT, Prosthodontics, Chulalongkorn University, Bangkok, Thailand and N. THAMRONGANANSKUL, Chulalongkorn University, Bangkok, Thailand

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IADR 2012  Abstract #693
Composite Inlays Luted with Self-Adhesive Cements: Microleakage Evaluation
D.P. LISE, Universidade Federal De Santa Catarina, Florianópolis, Brazil and G. LOPES, Universidade Federal De Santa Catarina, Lagoa da Conceicão, Florianopolis SC, Brazil

IADR 2012  Abstract #1017
Root-Canal Sealers Affect the Adhesion Between Fiber-Glass Post and Resin-Cements
F.P.P. LEITE, Universidade Federal De Juiz De For a, Juiz de Fora, MG, Brazil, F. CRUZ, Universidade Federal de Juiz de Fora, Juiz de Fora, Brazil, A.P.P. LEITE, Universidade Federal De Juiz De For a, Juiz de Fora, Brazil, F.V. DE LANDA, Pos Graduated — Master of Science, Juiz de Fora University, Juiz de Fora-MG, Brazil, F.D.R. GOYATA, Prosthetic Dentistry, Severino Sombra University, Resende, Brazil, R. CARVALHO, Federal University of Juiz de Fora, Juiz de Fora, Brazil and M. ÖZCAN, University of Zurich, Zurich, Switzerland

IADR 2012  Abstract #1018
Conventional Versus Self-Adhesive Resin-Cements and Resin-Modified-Glass-Ionomer Shear-Bond Strength to Enamel
R.F. RODRIGUES, C.R.B. ALENCAR, L.F. FRANCISCONI and P.A.S. FRANCISCONI, Bauru School of Dentistry — University of São Paulo, Bauru, Brazil

IADR 2012  Abstract #1027
Effect of EDTA on the Bond Strength of Resin Cements
L.A. ARANA¹, A.F. MONTENEGRO¹, D.F. ARANA², J. GOMES³ and O.M.M. GOMES⁴, ¹Dental Materials, Universidade Estadual De Ponta Grossa, Ponta Grossa, Brazil, ²Universidad Santiago de Cali, Cali, Colombia, ³Universidade Estadual De Ponta Grossa, Ponta Grossa, Paraná, Brazil, ⁴Dentistry, Universidade Estadual De Ponta Grossa, Ponta Grossa, Brazil

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RelyX™ U100 Self-Adhesive Universal Resin Cement (cont.)

IADR 2012 Abstract #1328
Influence of Sandblasting and Primers on Zirconia Bond Strength
L.A. SANTOS¹, P.C.G. OLIVEIRA¹, L.M. MENDONÇA¹, V. GUARÇONI DE PAULA¹, L.M. MARTINS² and F.C. LORENZONI¹, ¹Prosthodontics, Bauru School of Dentistry, University of São Paulo, Bauru, Brazil, ²College of Dentistry, Federal University of Amazonas, Bauru, Brazil

IADR 2012 Abstract #1334
Different Mechanical Tests to Evaluate Bond Strength on Y-TZP
A.C. OTANI¹, L. MAY¹, P.F. CESAR², M. AMARAL² and L.F. VALANDRO¹, ¹Universidade Federal De Santa Maria, Santa Maria, Brazil, ²Department of Dental Materials, Faculty of Dentistry — University of São Paulo (USP), São Paulo, Brazil, ³Dental Material and prosthesis, Universidade Est. Paulista Julio Mesquita, São José dos Campos, Brazil

IADR 2012 Abstract #1336
Retention of Direct Anatomic Posts in Different Root Thirds
D.M.S. PEDROSA¹, A.B. CORRER², L.R.M. MARTINS², M.A.C. SINHORETI², L. CORRER SOBRINHO², M.D. SOUSA-NETO², E.D. COSTA JR.², C.F. PEDROSA FILHO² and J.R. CARVALHO JR.², ¹Department of Dentistry, University of Brasilia, Brasilia, Brazil, ²Department of Restorative Dentistry, Piracicaba Dental School, State University of Campinas-UNICAMP, Piracicaba, Brazil, ³Department of Restorative Dentistry, University of São Paulo, Ribeirao Preto, Brazil

IADR 2012 Abstract #1338
Push-Out Tests to Evaluate Bond Strength on Y-TZP
A.B. VENTURINI¹, A.C. OTANI¹, M. AMARAL², L.G. MAY¹, P. CESAR³ and L. VALANDRO¹, ¹Universidade Federal De Santa Maria, Santa Maria, Brazil, ²Dental Material and prosthesis, Universidade Est. Paulista Julio Mesquita, São José dos Campos, Brazil, ³Dept. of Dental Materials, University of Sao Paulo, Sao Paulo, Brazil

IADR 2012 Abstract #1341
Bond Strength of an Experimental Film Deposited to Y-TZP Substrate
F. TADDEO, R.S. MEDEIROS, R. SGURA, J.P. CAPP and I.S. MEDEIROS, Departamento de Materiais Dentários, Faculdade de Odontologia/Universidade de São Paulo, São Paulo, Brazil

IADR 2012 Abstract #1345
Pull-Out Bond Strength: Effect of Resin Cement and Bone Level
M.L.L. ALVES¹, A. DAL PIWA², F. CAMPOS³, I.L.A. RIBEIRO², R. SOUSA³, R.O.A. SOUZA³ and M.A. BOTTINO³, ¹Department of Restorative Dentistry, Federal University of Paraiba, João Pessoa, Brazil, ²Universidade Federal Da Paraíba, João Pessoa, Brazil, ³Materiais Odontológicos e Prótese, Universidade Est. Paulista Julio Mesquita, São José dos Campos-SP, Brazil, ⁴Universidade Federal da Paraíba, João Pessoa, Brazil, ⁵Federal University of Paraíba, João Pessoa, PB, Brazil, ⁶Dental Materials and Prosthodontics, UNESP — Univ Estadual Paulista, Sao Paulo, Brazil

IADR 2012 Abstract #1407
Effect of Delayed Light Activation of Dual-Cured Self-Adhesive Resin Cements
C.R. AUGUSTO, S.M.W. SAMUEL and F.M. COLLARES, Universidade Federal do Rio Grande do Sul, Porto Alegre, Brazil

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RelyX™ U100 Self-Adhesive Universal Resin Cement (cont.)

IADR 2012  Abstract #1661
Effect of Thermocycling and Fatigue on Bond Strength to Ceramic
L. CORRER-SOBIRINHO1, A.R. COSTA1, M.A.C. SINHORETI2, R. PUPPIN-RONTANI3, A. VERSLUIS3 and F. GARCIA-GODOY4, 1Department of Restorative Dentistry, Piracicaba Dental School — State University of Campinas-UNICAMP, Piracicaba, Brazil, 2Department of Pediatric Dentistry, Piracicaba Dental School — State University of Campinas-UNICAMP, Piracicaba, Brazil, 3Bioscience Research, University of Tennessee Health Science Center, Memphis, TN, 4College of Dentistry, University of Tennessee, Memphis, TN

IADR 2012  Abstract #1964
Effect of Relining Procedure on Bond Strength of Fiber Posts
D.M.S. PEDROSA1, A.B. CORRER2, L.R.M. MARTINS3, M.A.C. SINHORETI2, L. CORRER SOBRINHO2, M.D. SOUSA-NETO3, E.D. COSTA JR.1, C.F. PEDROSA FILHO1 and J.R. CARVALHO JR.1, 1Department of Dentistry, University of Brasilia, Brasilia, Brazil, 2Department of Restorative Dentistry, Piracicaba Dental School, State University of Campinas-UNICAMP, Piracicaba, Brazil, 3Department of Restorative Dentistry, University of São Paulo, Ribeirão Preto, Brazil

IADR 2012  Abstract #2003
Effectiveness of Self-Adhesive Luting Cements to Bur-Prepared Dentin
F.B. PIVÊTA1, L.D.C. AZEVEDO1, M.F. DE GOES2, F.P. RODRIGUES1, P.H.P. D’ALPINO1 and V. DI HIPÓLITO1, 1Biomaterials Research Group, Anhanguera-Bandeirante University of São Paulo-UNIBAN, São Paulo, Brazil, 2Department of Restorative Dentistry, University of Campinas, Piracicaba, Brazil

IADR 2012  Abstract #2343
Tooth Temperature Effects on Polymerization Kinetics of Self-Adhesive Resin Cements
C.F.L. MADRUGA, C. LEVATTI, A. MUNHOZ, M. OLIVEIRA, A.F. REIS, J.A. RODRIGUES and C.A. ARRAIS, Operative Dentistry, Univ. de Guarulhos, Guarulhos, Brazil

IADR 2012  Abstract #2352
Finite Element Analysis of Photo-Activation Protocols of Resin Cement/Fiber-Post
A.D. VALDIVIA1, R.D. PEREIRA1, A.A. BICALHO1, D. TANTBIROJN2, A. VERSLUIS3 and C.J. SOARES1, 1Federal University of Uberlândia, Uberlândia-Minas Gerais, Brazil, 2Restorative Dentistry, University of Tennessee Health Science Center, Memphis, TN, 3Bioscience Research, University of Tennessee Health Science Center, Memphis, TN

IADR 2012  Abstract #2367
Abutment and Luting Agent Influence on Cemented Implant Restorations
T.S. DANTAS, Prótese Fixa, Oclusão e Materiais Odontológicos, Universidade Federal de Uberlândia, Uberlândia, Brazil, F. NEVES, Universidade Federal de Uberlândia, Uberlândia-MG, Brazil, L.Z. NAVES, UNIVERSIDADE ESTADUAL DE CAMPINAS — Faculdade de Odontologia de Piracicaba, Piracicaba, Brazil and R.F. RIBEIRO, Department of Dental Materials and Prosthodontics, University of São Paulo, Ribeirão Preto, Brazil

IADR 2012  Abstract #2696
Curing Mode Influences the Monomer Conversion of Self-Adhesive Resin Cement
E. OZERA1, E.J. SOUZA-JÚNIOR2, M.A.C. SINHORETI1, W.C. BRANDT4, R.C.B. ALONSO2 and R.M. PUPPIN-RONTANI1, 1Department os Restorative Dentistry — Dental Materials Area, University of Campinas-UNICAMP — Piracicaba Dental School, Piracicaba, Brazil, 2Restorative Dentistry, Piracicaba Dental School — UNICAMP, Piracicaba, Brazil, 3Restorative Dentistry, Piracicaba Dental School/State University of Campinas, Piracicaba, Brazil, 4Restorative Dentistry, Universidade de Taubate, Taubate, Brazil, 5Biomaterials, Bandeirante University of São Paulo-UNIBAN, Piracicaba-SP, Brazil
RelyX™ U100 Self-Adhesive Universal Resin Cement (cont.)

IADR 2012  Abstract #162559
**Effect of Thermocycling on the Microhardness of Luting Cements Posts**
A.C. ZAVANELLI, J.V.O. MAZARO, R.A. ZAVANELLI, A.T. KIAN, A.P. AMOROSO and H. GENNARI FILHO, 1Dental Materials and Prosthodontics, Universidade Est. Paulista Julio Mesquita, Aracatuba, Brazil, 2Department of Prevention and Oral Rehabilitation, Universidade Federal de Goias, Goiânia, Brazil

IADR 2012  Abstract #166638
**Different Root Conditioning on the Tensile Strength of Fused Pins**
M. FERNANDES, Odontologia, Faculdade de Odontologia São Leopoldo Mandic, São Sepé, Brazil and C. BRAGA SR., Odontologia, Faculdade de Odontologia São Leopoldo Mandic, Porto Alegre-RS, Brazil

**Lava™ Zirconia**

AADR

AADR 2012  Abstract #235
**Biaxial Flexural Strength of a New Dental Zirconia Ceramic**
Y. VENTO, J. LONDONO, G. CHICHE, D. METTENBURG, W. TWIGGS and F. RUEGGEBERG, Oral Rehabilitation, Georgia Health Sciences University, Augusta, GA

AADR 2012  Abstract #1001
**Shear–Bond-Strength of Self-Adhesive Resin Cements (Lithium Disilicate/Zirconia) to Dentin**
N. FREDA, D. NILL, R.D. PERRY, J. TOWERS, G. KUGEL and M. HARSONO, Tufts University, Boston, MA

AADR 2012  Abstract #1006
**CAD/CAM Ceramic Crown Retention of Resin Cements**
D. KOJIC, S. SINGHAL, S. JANYAVULA, D. CAKIR, P. BECK, L. RAMP and J. BURGESS, University of Alabama at Birmingham, Birmingham, AL

AADR 2012  Abstract #1010
**Retention of Zirconia Crowns Bonded with Adhesive Resin Cements**
Q. CAI, D. CAKIR, P. BECK, L. RAMP and J. BURGESS, University of Alabama at Birmingham, Birmingham, AL

AADR 2012  Abstract #1223
**Veneer Thickness Ratio and Layering Methodology Effect Layered Zirconia Strength**
J. SORENSEN, T. HILL and K. CHLOSTA, 1Pacific Dental Institute, Portland, OR, 2Ivoclar Vivadent, Inc, Amherst, NY

AADR 2012  Abstract #1025
**Bond Strength of Self-Adhesive Resin Cements to Zirconia**
T.M. DIAS, M. DI FRANCESCANTONIO, R.R. PACHECO and M. GIANNINI, 1Restorative Dentistry, State University of Campinas, Piracicaba, SP, Brazil, Piracicaba, SP, Brazil, 2Restorative Dentistry, State University of Campinas, Piracicaba, SP, Brazil, 3Department of Restorative Dentistry, University of Campinas — Piracicaba Dental School, Piracicaba, Brazil
Lava™ Zirconia (cont.)

AADR 2012  Abstract #1995
Ceramic’s Surface Roughness and Bond Strength: Influence of Sandblasting Protocols
R.S. SOUSA¹, F. CAMPOS², M.L.L. ALVES³, A. DAL PIVA², I.L.R. ARRAES¹, R.O.A. SOUZA¹, M.A. BOTTINO⁴ and L.D. GONDIM¹, ¹Universidade Federal Da Paraiba, João Pessoa, Brazil, ²Materiais Odontológicos e Prótese, Universidade Est. Paulista Julio Mesquita, São José dos Campos, SP, Brazil, ³Department of Restorative Dentistry, Federal University of Paraiba, João Pessoa, Brazil, ⁴Dental Materials and Prosthodontics, UNESP — Univ Estadual Paulista, Sao Paulo, Brazil

CED

CED 2011  Abstract #118
Zirconia Ceramic Resin Cement Bonding
J.L. ROMÁN RODRÍGUEZ, A. FONS FONT II, M. GRANELL RUÍZ, R. AGUSTÍN PANADERO SR., C. LABAIG RUEDA and M.F. SOLÁ RUÍZ, Department of Buccofacial Prosthetics, Faculty of Medicine and Dentistry, University of Valencia, Spain, Valencia, Spain

CED 2011  Abstract #119
Bond Strength of Composite to Different Zirconia Ceramic Materials
P. HAHN¹, M. MEHLICH¹ and M. WOLKEWITZ², ¹Dept. of Operative Dentistry and Periodontology, University Medical Center Freiburg, Freiburg, Germany, ²Institute of Medical Biometry and Medical Informatics, Freiburg, Germany

CED 2011  Abstract #154
3D-Surface Roughness, Microstructure and Monoclinic-Phase Distribution in Y-TZP CAD/CAM Frameworks
G. ELIADES¹, V. KYPRIAIOS², S. PELEKANOS² and S. ZINELIS¹, ¹Department of Biomaterials, School of Dentistry, University of Athens (EKPA), Athens, Greece, ²Prosthodontics, University of Athens, Athens, Greece
Vanish™ 5% Sodium Fluoride White Varnish with Tri-Calcium Phosphate (TCP)

Fluoride Released From Fluoride Varnish Three Hours After Application

P.J. Flanigan*, a) R. Rusin, a) J.A. Fitch, a) pjflanigan@mmm.com a) 3M ESPE, St.Paul, MN U.S.A.

Fluoride varnishes prolong contact time between fluoride and enamel. Varnishes remain on tooth surfaces for 24 hours or more and act as a slow-releasing reservoir of fluoride.

**Objectives:** The aim of this study was to evaluate the rate of fluoride release from three varnishes: A = 3M™ ESPE™ Vanish™ White Varnish, B = Premier™ Enamel Pro™ Varnish, C = Colgate™ Duraphat™ Varnish, more than 3 hours after application.

**Methods:** Varnish (0.042g ± 0.05g) was coated on a plastic slide (n = 3) over 2 inches² and submerged into an agitated TISAB/water solution containing an ion-specific fluoride electrode. The fluoride in the solution was measured every 10 seconds for 15 minutes and thereafter every minute using a Mettler Titrator. MilliVolts were converted to ppm using a standardized curve and percent fluoride released was calculated based on product label (5%NaF, 22624.43ppm) and initial sample weight. Fluoride released is reported in percent of total fluoride content.

**Results:** More fluoride was released in the first minute than in any other time interval: A = 0.27%, B = 8.62%, C = 8.41%. After 3 hours, all varnishes released fluoride according to a linear model, slope (R2): A = 3.0%/hour (0.993), B = 1.1%/hour (0.955), C = 0.3%/hour (0.995). At 24 hours, most of the contained fluoride was released from varnishes A and B, but not C. (A = 83.32%, B = 71.82%, C = 20.22%).

**Conclusions:** This model assumes all of the varnish remains on the tooth surface. After the 3rd hour, Varnish A and B continue to deliver fluoride, varnish A delivers 11.5% more. In the mouth where saliva continuously baths the varnish, the ability of varnish to continuously release fluoride is beneficial. The varnish that released low levels of fluoride initially, exhibited the highest sustained rate of fluoride release for the long term. This is likely related to the varnish’s unique prolonged setting.

**3M ESPE Summary**

**Aim of Study:** Compare the rate of fluoride release from three varnishes more than 3 hours after application: 3M ESPE Vanish White Varnish, Premier™ Enamel Pro™ Varnish and Colgate™ Duraphat™ Varnish.

**Summary of Results:** Vanish™ 5% Sodium Fluoride White Varnish with Tri-Calcium Phosphate (TCP) continued to deliver fluoride after the 3rd hour through 24 hours. In the mouth where saliva continuously baths the varnish, the ability of varnish to continuously release fluoride is beneficial. While its initial fluoride release was lower than the other varnishes, Vanish 5% Sodium Fluoride White Varnish with Tri-Calcium Phosphate (TCP) exhibited the highest sustained rate of fluoride release over the full 24 hour period. This is likely related to the varnish’s unique prolonged setting.
Effect of Placing an Opaque Sealant on Canary Number Readings

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Objectives: This investigation examined the influence of dental sealant on Canary Number (CN) readings measured by The Canary System (CS), an infrared photothermal radiometry and modulated luminescence-based device. The first study measured baseline CN readings of the sealant material. The second study evaluated the ability of CS to detect decay beneath dental sealant compared to other caries detections methods, DIAGNOdent (DD) and ICDAS II visual scoring.

Methods: In the first study, four blocks of sealant (3M™ ESPE™ Vanish™ XT Extended Contact Varnish) 2mm in thickness and sealant placed in 4mm deep and 2mm deep holes drilled in 8 healthy extracted human molars were scanned with CS and DD. In the second study, 28 extracted human molars and premolars composed of 103 potential healthy and carious pits/fissures on their occlusal surfaces, as determined by ICDAS II scoring criteria, were used. After scanning marked pits/fissures with CS and DD, teeth were sealed with 3M ESPE sealant by a clinician. Following sealant placement, teeth were re-scanned at the same sites as before with CS and DD. Using polarized light microscopy (PLM), examined sites were scored as ‘carious’ or ‘non-carious’.

Results: Baseline CN readings of the sealant were in the healthy zone (CN ≤ 20). In the second study, with PLM as gold standard, sensitivities/specificities of CS, DD and ICDAS II before sealant placement were 0.92/0.70, 0.41/1.0 and 0.77/0.90, respectively and after sealant placement were 0.83/0.79 and 0.64/0.46 for CS and DD respectively. Correlations of CN with DD and ICDAS before sealant were 0.50 and 0.80 respectively and after sealant was 0.44 with DD.

Conclusions: This study highlighted the potential of the Canary System to assist dental professionals to detect the presence of caries beneath sealants. The caries detection ability of the Canary System was not affected by sealant and was more accurate than DIAGNOdent.

3M ESPE Summary

Aim of Study: Determine the effect of an RMGI sealant material on Canary Number (CN) readings; and, compare the CS ability to detect decay beneath sealant to DD and ICDAS scoring.

Summary of Results: The presence of an RMGI sealant material did not affect the caries detection ability of CS. Differences in sensitivity and specificity between CS, DD and ICDAS II were detected, in comparison to reference method PLM.
Vanish™ 5% Sodium Fluoride White Varnish with Tri-Calcium Phosphate (TCP)

Clinical Monitoring of White Spot Lesions in Children: 24-Month Data

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Objectives: The objective of this clinical study is to determine the ability of visual and instrumental procedures to monitor changes in white spot lesions in children.

Methods: A total of 121 children (50 girls; 71 boys) 8—17 years of age with two white spot lesions began the study in a private pediatric dental practice following IRB approval. The subjects were told to use a provided fluoride dentifrice (Crest) twice daily (unsupervised) throughout the entire length of the study. White spots were examined visually for evidence of lesion activity for two phase intervals using the ICDAS procedure and using light fluorescence assessments made by two different instruments: QLF-Inspektor™ Pro (QLF) and FluoreCam® (FC). Phase 1 = baseline, 3, & 6 month exams; Phase 2 = baseline (beginning at 6), 12, 18, & 24 months. Subjects began receiving fluoride varnish applications (Vanish; 3M ESPE) at their 6-month visit and at all subsequent study visits. Subjects will be seen for one additional visit when 30-month data will be collected.

Results: ICDAS data revealed that the likelihood of having a lower activity score at a later visit was significantly higher than at baseline. This is interpreted as remineralization. Mean fluorescence measurements at 0, 3, 6, 12, 18 and 24 months were 11.51, 11.45, 10.53, 9.79, 9.47 and 8.50 for FC and 12.48, 12.00, 10.72, 10.45, 9.54 and 8.87 for QLF. Similar to ICDAS, both instruments detected remineralization during both phases of the study. The amount of remineralization observed during phase 1 was statistically significant for QLF and for phase 2 was statistically significant for both QLF and FC.

Conclusions: These preliminary data from an ongoing clinical study suggest that clinical ICDAS lesion activity assessments and measurements from both fluorescence instruments are able to significantly monitor changes in white spot lesions.

This abstract is based on research that was funded entirely or partially by an outside source: Funding by NIH/NIDCR: R01 DE017875

3M ESPE Summary

Aim of Study: The aim of this study was to clinically monitor (with visual and instrumental procedures) white spot lesion progression in children using a regimen of regular oral hygiene and a fluoride varnish containing a remineralization promoting agent.

Summary of Results: Over the course of the study, both visual and instrumental detection methods were able to detect reductions in white spot lesion progression after regular brushing coupled with additional treatments of Vanish 5% Sodium Fluoride White Varnish with Tri-Calcium Phosphate (TCP).
Vanish™ XT Extended Contact Varnish

Mastication Resistance of an RMGI Coating Material in an Artificial Oral Environment

Rusin RP* a) Pintado M b), Douglas WH b), Fok A c), Tantbirojn D c), DeLong R b). rprusin@mmm.com; a) 3M ESPE, St. Paul, MN, USA b) University of Minnesota, Minneapolis, MN, USA c) University of Tennessee, Memphis, TN, USA

Objectives: Sealants are critical in the prevention of tooth decay; however, they must endure the severe stress of chewing in order to perform this function. The aim was to determine the wear and adherence of sealants under simulated non-contact chewing conditions with a food bolus. Sealants studied were 3M™ ESPE™ Vanish™ XT Extended Contact Varnish (VXT: resin-modified glass ionomer); 3M™ ESPE™ Clinpro™ Sealant (CP: resin); GC™ Fuji™ Triage Capsule (FT: glass ionomer).

Methods: Human maxillary third molars were scanned with a contact digitizer before and after sealant placement per manufacturer’s instructions. Mastication with opposing human palatal cusp and food bolus (millet & rice) was done in an Artificial Oral Environment (DeLong et al, 1991): 37°C, 150k cycles, 10–12 N load, 1mm lateral excursion, n = 5. Teeth were scanned after mastication; digital scans were analyzed with Ansur© software (DeLong, 2007) to calculate volume and depth differences. Data were analyzed via one-way ANOVA and compared with Tukey’s T-test (p < 0.05).

Results: Volume change (mm3, mean (SD) and depth change (mm, mean (SD): VXT 0.778( 0.606)A, 0.001 (0.013)a; FT 1.620 (1.074)A, 0.003 (0.024)a, CP 1.226 (1.276)a, 0.004 (0.029)a. Superscript letters denote groups that are not statistically different.

Conclusions: The total volumetric and depth wear of all three materials were not statistically different. Both FT and CP showed evidence of material flaking away in the regions around the two-body contact; VXT did not show this effect. Thus, it is concluded that VXT resists chewing wear as well as CP and FT in this in vitro model.

Supported in part by a 3M Non-tenured Faculty Grant and by 3M ESPE

3M ESPE Summary

Aim of Study: Compare the wear and adherence under simulated non-contact chewing conditions with a food bolus of 3M ESPE Vanish XT Extended Contact Varnish with a resin sealant (3M ESPE Clinpro Sealant) and a glass ionomer sealant (GC Fuji Triage Capsule).

Summary of Results: The total volumetric and depth wear of all three materials were not statistically different. Vanish XT Extended Contact Varnish remained adherent and did not show evidence of material flaking away. Vanish XT Extended Contact Varnish resisted chewing wear as well as a resin sealant and a glass ionomer sealant in this in vitro model.
Vanish™ XT Extended Contact Varnish

Fluorine Analysis of Cavity Walls in Glass-Ionomer Restorations Using PIGE/PIXE System

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Objectives: The purpose of this study was to determine fluorine (F) distribution in cavity wall of glass-ionomer restorations using the proton induced gamma-ray emission and proton induced X-ray emission or PIGE/PIXE system.

Methods: Class V cavities in buccal surfaces of eight extracted human teeth were drilled and filled with four glass-ionomer cements; Fuji IXGP FAST CAPULE (FF), Fuji IXGP EXTRA (FE), RIVA S/C (RV) and Clinpro™ XT Varnish Durable Fluoride-Releasing Coating (CX). After storing in water for 1 month, two longitudinal sections including materials were obtained from each tooth. F and calcium distribution of specimens were evaluated using PIGE/PIXE system and F uptake into enamel and dentin cavity walls from the material was analyzed (n = 8). The margin of cavity wall was defined as the spot containing 90% of calcium concentration in intact tooth. For the comparison of F uptake, the average F concentration (ppm) in each specimen was calculated at area 200μm from the cavity margin. One-way ANOVA and Games-Howell test were used for analysis (p < 0.05).

Results: F distribution in all specimens represented that highest F concentration was at area of cavity margin and decreased as distance increased from cavity margin. There was no significant difference in F concentration at area of cavity margin among the materials in enamel cavity, while the concentration in dentin cavity for FE and CX were significantly higher than that for FF and RV. For F uptake, there was no significant difference among materials in enamel cavity, although F uptake from FE and CX were higher than that from FF and RV.

Mean (SD)

<table>
<thead>
<tr>
<th>Area</th>
<th>FF Enamel</th>
<th>FF Dentin</th>
<th>FE Enamel</th>
<th>FE Dentin</th>
<th>RV Enamel</th>
<th>RV Dentin</th>
<th>CX Enamel</th>
<th>CX Dentin</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cavity Margin</td>
<td>2283 (959)</td>
<td>5817 (3885)</td>
<td>3965 (1884)</td>
<td>22222 (5714)</td>
<td>1561 (1556)</td>
<td>4479 (2311)</td>
<td>2965 (3571)</td>
<td>15043 (4202)</td>
</tr>
<tr>
<td>200 µm from Margin</td>
<td>135 (57)</td>
<td>940 (1218)</td>
<td>309 (196)</td>
<td>5817 (2350)</td>
<td>92 (92)</td>
<td>443 (304)</td>
<td>262 (324)</td>
<td>4308 (1408)</td>
</tr>
</tbody>
</table>

Conclusions: Among materials used in current study, there were some differences in F uptake, which could possibly lead to obtaining differences in clinical performance. The data obtained using PIGE/PIXE system was useful to understand fluoride benefit for preventing caries by mean of fluoride-containing material.

3M ESPE Summary

Aim of Study: Determine the fluorine (F) distribution within the cavity wall of glass-ionomer restorations via proton induced gamma-ray emission and proton induced X-ray emission.

Summary of Results: While there were no significant differences among material in F concentration at the enamel cavity margin, the concentration in the dentin cavity for CX and FE were significantly higher than FF and RV. The fluoride uptake due to CX and FE was higher than that from FF and RV.
Vanish™ 5% Sodium Fluoride White Varnish with Tri-Calcium Phosphate (TCP)

Fluoride Varnish Migration and Fluoride Bioavailability

P. KLAIBER, 3M ESPE, St. Paul, MN and V. KOLB, 3M ESPE, St. Paul, MN

Objectives: To measure fluoride varnish migration and salivary fluoride concentration after application and determine whether a positive correlation between the two exists.

Methods: Consenting adult volunteers (n = 20) with normal salivary flow (0.5 to 3.0mL/minute) were enrolled into this IRB-approved study. The study utilized a randomized, single-blind, crossover design; all subjects received all treatments. Treatments consisted of 50mg of varnish applied to the facial surfaces of the eight anterior maxillary teeth by a trained dental professional. Following application, the number of surfaces covered with varnish was determined by subject self assessments and recorded on simple diagrams of the dentition 1 hour after application. Fluoride concentrations in saliva collected 1hr after varnish application were determined using a calibrated fluoride ion selective electrode and compared to baseline fluoride concentrations. Products compared were: (A) Vanish™ 5% Sodium Fluoride White Varnish with Tri-Calcium Phosphate (TCP) (3M ESPE), (B) Colgate® PreviDent® Varnish and (C) VarnishAmerica™ White. Tooth surfaces covered and salivary fluoride concentrations were compared using one-way ANOVA (p < 0.05).

Results: The mean number of covered tooth surfaces and mean salivary fluoride concentrations along with their corresponding standard errors are reported in the Table. Varnish A was observed on a greater number of tooth surfaces than B and C 1 hour after application (A > B and A > C). Correspondingly, varnish A exhibited greater salivary fluoride concentration than B and C after 1 hour (A ≥ B and A > C).

<table>
<thead>
<tr>
<th>Varnish</th>
<th>Mean Surfaces Covered at 1 Hour</th>
<th>Mean Fluoride Concentration Above Baseline at 1 Hour</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>19.00 ± 1.82</td>
<td>5.84 ± 0.93</td>
</tr>
<tr>
<td>B</td>
<td>14.45 ± 1.21</td>
<td>4.66 ± 0.57</td>
</tr>
<tr>
<td>C</td>
<td>10.40 ± 0.86</td>
<td>3.33 ± 0.41</td>
</tr>
</tbody>
</table>

Work and Fmax were evaluated by linear regression for their correlation with instrument stringiness rating at either condition. Work correlated best with stringiness, $R^2 = 71\%$ for 1 second and 8mm/second and $R^2 = 73\%$ for 20 seconds and 1mm/second.

Conclusions: Varnish A was present on statistically significantly more surfaces than varnish B and varnish C, demonstrating its ability to migrate across tooth surfaces after application. Varnish A also exhibited greater salivary fluoride concentrations 1 hour after application suggesting the unique migration performance provides higher levels of bioavailable fluoride, in vivo.

Study supported by 3M ESPE

3M ESPE Summary

Aim of Study: The aim of this in vivo study was to measure fluoride varnish migration as well as salivary fluoride content and to determine if there was a correlation between the two.

Summary of Results: The varnish that migrated to additional, untreated tooth surfaces (Vanish 5% Sodium Fluoride White Varnish with Tri-Calcium Phosphate [TCP]) also had statistically higher salivary fluoride measurements than the other products tested suggesting that its unique ability to migrate may enhance fluoride bioavailability in vivo.

Results found in abstracts for Vanish™ 5% Sodium Fluoride White Varnish with Tri-Calcium Phosphate (TCP) also apply to products registered under the following name(s): Clinpro™ 5% Sodium Fluoride White Varnish with Tri-Calcium Phosphate.
Vanish™ 5% Sodium Fluoride White Varnish with Tri-Calcium Phosphate (TCP)

Evaluation of Proposed Total Fluoride Method for Varnishes

P.J. FLANIGAN1, F. VANG1, P.R. KLAIBER1, J.A. FITCH1 and C.L. MIYAZAKI2, 13M ESPE, Saint Paul, MN; 2Dental Materials, University of Sao Paulo — Sao Paulo, Brazil

Objectives: Currently, there is no universally-accepted method to determine total fluoride in 5% NaF-varnishes. A working group has drafted a test method and here we share important modifications and share results for: A = Colgate® Duraphat® Varnish, B = 3M™ ESPE™ Clinpro™ Vanish™ 5% Sodium Fluoride White Varnish with Tri-Calcium Phosphate (TCP), C = Premier® Enamel Pro™ Varnish, D = Colgate® PreviDent® Varnish, E = Kolorz® ClearShield®, F = Control 2% wt/wt NaF-Solution, G = Fluoride-Standard-1000ppm-RICCA Chemical Company®.

Methods: The draft method involves varnish (0.1–0.2mL) added to a mixture of chloroform (4.0mL) and TISAB (10.0mL) in a glass vial followed by vigorous shaking, stirring (1.5 hours) and settling (> 30 minutes). Once settled, 1.0mL of the aqueous layer (top) is mixed with 1.0mL of DI water and 18.0mL of a 50/50 TISAB/Water solution. The sample is measured using a calibrated fluoride-ion selective electrode (F-ISE) and NaF standards at 0.0001, 0.001 and 0.01 mol/L in an equal volume of TISAB solution.

Results: Modifications to the test method included: mix the varnish completely prior to adding to chloroform and then add TISAB. Vigorously shake the solution for > 6 minutes by hand (with periodic venting) to ensure the fluoride is extracted to the aqueous layer and settle for at least 24 hours. Create a standard curve using five fluoride standards (1, 2, 10, 50 and 100ppm) in TISAB and determine F-concentration.

<table>
<thead>
<tr>
<th>Product</th>
<th>N</th>
<th>Mean</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>5</td>
<td>21875</td>
<td>1489</td>
</tr>
<tr>
<td>B</td>
<td>5</td>
<td>20979</td>
<td>455</td>
</tr>
<tr>
<td>C</td>
<td>5</td>
<td>7623</td>
<td>811</td>
</tr>
<tr>
<td>D</td>
<td>5</td>
<td>23203</td>
<td>1717</td>
</tr>
<tr>
<td>E</td>
<td>5</td>
<td>21656</td>
<td>1442</td>
</tr>
<tr>
<td>F</td>
<td>5</td>
<td>9125</td>
<td>211</td>
</tr>
<tr>
<td>G</td>
<td>5</td>
<td>1001</td>
<td>8</td>
</tr>
</tbody>
</table>

Pooled SD = 1079

Varnishes A, B, C, D, E were evaluated, n = 5, using the modified method. Controls F, G were also evaluated. Mean ppm values and standard deviations are shown in the figure below. Varnish A is considered the industry standard and labels state that each varnish contains 5% NaF (22624ppmF).

Varnish B, D, E exhibited fluoride content that was not statistically significantly different than A and varnish C was statistically significantly different. Varnish-C contains Amorphous-Calcium-Phosphate (ACP), which can react with fluoride.

Conclusions: The proposed method may not be a good tool to measure total fluoride, especially for varnishes that contain ACP.
Vanish White Varnish + TCP (cont.)

3M ESPE Summary

Aim of Study: The aim of this study was to determine if a proposed test method for measuring total fluoride content of 5% NaF containing varnishes was sufficient, or if modifications to the method were necessary.

Summary of Results: The proposed test method needed two important modifications in order to recover statistically equivalent quantities of fluoride in all products and controls tested and even then was not able to recover an equivalent quantity from an ACP containing varnish. Additional test method development is recommended to address all products and their respective differences.
Clinpro™ Tooth Crème

In-Vitro Remineralization of NaF Pastes Containing TCP or CPP-ACP

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Objectives: The purpose of this study was to evaluate the white-spot lesion remineralization potential of Clinpro™ Tooth Crème (950 ppm F plus TCP) and MI Paste Plus (900 ppm F plus CPP-ACP) relative to a fluoride-free dentifrice.

Methods: White-spot lesions were initially formed in bovine enamel by immersion in a Carbopol-lactic acid solution saturated with 50% hydroxyapatite (pH = 4.9) for 50 hours (37°C) and stratified into three treatment groups (N = 10): A: fluoride-free Silly Strawberry (Tom’s of Maine); B: MI Paste Plus (GC America); C: Clinpro Tooth Crème (3M ESPE). The groups were then immersed upside-down in a daily regimen consisting of four one-minute treatments (three-fold dilution with distilled water), one four-hour acid challenge (Carbopol-lactic acid, pH = 4.9) and artificial saliva (pH = 7.0) exposure in between these events. The treatment slurries and artificial saliva were continuously agitated at 300 rpm while the acid challenge was static. Each day the artificial saliva and acid solution were refreshed. After 10 days, microhardness measurements were performed at the enamel surface (percent surface microhardness recovery, % SMHR) and subsurface (relative lesion size, ΔZ, √KHN•µm).

Results: Mean (SEM) % SMHR were as follows: A: -3.4 (1.9); B: -1.0 (0.5); C: 22.6 (3.8), with A ≤ B < C (ANOVA, Tukey, p < 0.05). Mean (SEM) ΔZ calculations were as follows: A: 613.7 (19.5); B: 514.5 (40.7); C: 191.8 (13.8), with A > B > C (ANOVA, Tukey, p < 0.05).

Conclusions: Statistical splitting was observed between pastes A and C demonstrates the model is sensitive to standard fluoride levels in topical pastes. Paste C produced statistically superior surface and subsurface strengthening relative to pastes A and B. These pilot results suggest Clinpro Tooth Crème may provide additional anti-caries benefits relative to MI Paste Plus.

This abstract is based on research that was funded entirely or partially by an outside source: 3M ESPE

3M ESPE Summary

Aim of Study: Determine the potential of three dentifrices to remineralize white spot lesions: Clinpro Tooth Crème (950ppm F plus TCP), MI Paste Plus (900ppm F plus CPP-ACP), and Tom’s of Maine (fluoride-free).

Summary of Results: Clinpro Tooth Crème resulted in statistically significantly greater strengthening of the surface and the subsurface body of the lesions than both MI Paste Plus and the fluoride free-dentifrice.

Results found in abstracts for Clinpro™ Tooth Crème also apply to products registered under the following name:
Clinpro™ 5000 1.1% Sodium Fluoride Anti-Cavity Toothpaste.
Lesion Formation Inhibition with NaF Pastes Containing TCP or CPP-ACP

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**Objectives:** This study evaluated the potential of Clinpro™ Tooth Crème (950ppm F plus TCP) and MI Paste Plus (900ppm F plus CPP-ACP) to inhibit white-spot lesion formation relative to a fluoride-free dentifrice.

**Methods:** Ground and polished bovine specimens were mounted in acrylic rods, analyzed for baseline microhardness and divided into three groups (N = 8): 1: fluoride-free Silly Strawberry (Tom’s of Maine); 2: MI Paste Plus (GC America); 3: Clinpro Tooth Crème (3M ESPE). The groups were immersed upside-down in a daily cycling regimen consisting of two one-minute treatments (four-fold dilution with distilled water) separated by one seven-hour acid challenge (Carbopol-lactic acid saturated with 50% hydroxyapatite, pH = 4.9). After the second treatment, specimens were immersed in artificial saliva (pH = 7.0). The treatment slurries and artificial saliva were continuously agitated at 300rpm while the acid challenge was static. The artificial saliva and acid solution were refreshed daily. After 14 days, surface microhardness measurements were made (percent surface microhardness loss, %SMHL), followed by fluoride uptake measurements (EFU, μg F/cm², N = 4) and cross-sectional microhardness (relative lesion size, ΔZ, √KHN•µm, N = 4).

**Results:** Mean Statistical comparisons were made using ANOVA, Tukey, p < 0.05. Mean (SEM) %SMHL were as follows: A: 78.7 (1.0); B: 70.8 (2.5); C: 60.0 (2.5), with C < B < A. Mean (SEM) EFU were as follows: A: 1.4 (0.2); B: 2.1 (0.3); C: 2.4 (0.8), with A = B = C. Mean (SEM) ΔZ calculations were as follows: A: 736.3 (57.5); B: 504.9 (32.7); C: 301.7 (36.8), with A > B > C.

**Conclusions:** Statistical splitting between the two fluoride groups and the placebo demonstrates model sensitivity to standard fluoride levels of topical pastes. Although no significant differences were observed in fluoride uptake, both fluoride groups exhibited protection against white-spot lesion formation relative to placebo. Paste C improved lesion inhibition at both the enamel surface and subsurface relative to paste B. These results suggest Clinpro Tooth Crème may provide additional lesion formation protection relative to MI Paste Plus.

**3M ESPE Summary**

**Aim of Study:** Determine the potential of three dentifrices to inhibit the formation of white spot lesions: Clinpro Tooth Crème (950ppm F plus TCP), MI Paste Plus (900ppm F plus CPP-ACP), and Tom’s of Maine (fluoride-free).

**Summary of Results:** While the enamel fluoride uptake of the three dentifrices was statistically not different, both fluoride dentifrices displayed statistically greater protection against white-spot lesion formation than the fluoride-free dentifrice. Lesion inhibition at both the enamel surface and subsurface with Clinpro Tooth Crème was statistically significantly greater than both MI Paste Plus and the fluoride free-dentifrice.
Lesion Formation Inhibition with TCP or Novamin Dentifrices In Vitro

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Objectives: This study evaluated the potential of Clinpro™ 5000 1.1% Sodium Fluoride Anti-Cavity Toothpaste (5,000ppm F plus TCP), Sensodyne NUPRO 5000 (5,000ppm F plus Novamin) and Renew (5,000ppm F plus Novamin) to inhibit white-spot lesion formation relative to a fluoride-free dentifrice.

Methods: Ground and polished bovine specimens were mounted in acrylic rods, analyzed for baseline microhardness and divided into four groups (N = 8): 1: Fluoride-free Silly Strawberry (Tom’s of Maine); 2: Clinpro 5000 1.1% Sodium Fluoride Anti-Cavity Toothpaste (3M ESPE); 3: Sensodyne NUPRO 5000 (DENTSPLY); and 4: Renew (Sultan Healthcare). The groups were immersed upside-down in artificial saliva (pH = 7.0) and cycled through a daily regimen of two one-minute treatments (four-fold dilution with distilled water) separated by one seven-hour acid challenge (Carbopol-lactic acid saturated with 50% hydroxyapatite, pH = 4.9). After 14 days, surface microhardness measurements were made (percent surface microhardness loss, %SMHL), followed by fluoride uptake measurements on four of the specimens (EFU, μgF/cm²), with the rest analyzed for cross-sectional microhardness (relative lesion size, ΔZ, √KHN•µm).

Results: All statistical comparisons were made using ANOVA, Tukey, p < 0.05. Mean (SEM) %SMHL were as follows: 1: 78.7 (1.0); 2: 41.6 (5.2); 3: 63.3 (2.1); 4: 57.2 (3.0), with 2 < 4 ≤ 3 < 1. Mean (SEM) EFU were as follows: 1: 1.4 (0.2); 2: 4.4 (0.4); 3: 2.7 (0.4); 4: 3.7 (0.1), with 1 < 4 ≤ 3 = 2. Mean (SEM) ΔZ calculations were as follows: 1: 736.3 (57.5); 2: 223.1 (23.2); 3: 241.9 (25.7); 4: 230.8 (47.7), with 1 > 4 = 3 = 2.

Conclusions: Statistical splitting among the groups relative to the placebo demonstrates model sensitivity to prescription-strength levels of fluoride. All three 5,000ppm F pastes exhibited promising protection against white-spot lesion formation. No significant differences were observed among the three 5,000ppm F pastes within the subsurface enamel lesion; however, Clinpro 5000 1.1% Sodium Fluoride Anti-Cavity Toothpaste produced superior lesion inhibition at the enamel surface and produced the greatest fluoride uptake relative to the other two 5,000ppm F pastes. These pilot results suggest Clinpro 5000 1.1% Sodium Fluoride Anti-Cavity Toothpaste may provide additional protection against lesion formation relative to Sensodyne NUPRO 5000 and Renew.

This abstract is based on research that was funded entirely or partially by an outside source: 3M ESPE.

3M ESPE Summary

Aim of Study: Compare the potential to inhibit white-spot lesion formation of Clinpro 5000 1.1% Sodium Fluoride Anti-Cavity Toothpaste, Sensodyne NUPRO 5000 and Renew.

Summary of Results: While inhibition within the subsurface enamel lesion was not statistically different between the three 5,000ppm F pastes, Clinpro 5000 1.1% Sodium Fluoride Anti-Cavity Toothpaste resulted in superior inhibition of lesion formation at the enamel surface and higher fluoride uptake than the other pastes. These results suggest that Clinpro 5000 1.1% Sodium Fluoride Anti-Cavity Toothpaste has the potential to provide additional protection against lesion formation compared to Sensodyne NUPRO 5000 and Renew.
Clinpro™ Sealant

Self-Adhesive Flowable Composite-Resin as a Fissure Sealant: A Microleakage Study
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Objectives: To evaluate the sealing ability of a self-adhesive flowable composite-resin (Fusio Liquid Dentin, Pentron) with different treatments of the enamel surface used as a fissure sealant.

Methods: 140 recently extracted human third molars were selected. The roots were covered with 3 layers of nail varnish to avoid unwanted leakage. Teeth were randomly divided into four groups (n = 35) and received an enamel surface treatment and a sealant application. The following groups were established: Group 1 (control), acid etching (37% H3POO4), rinsing (20s), air drying (10s) and sealant (Clinpro Sealant, 3M ESPE); Group 2, acid etching (37% H3POO4), rinsing (20s), air drying (10s) and self-adhesive flowable composite-resin (Fusio Liquid Dentin, Pentron); Group 3, self-adhesive flowable composite-resin; Group 4, sandblasting (10s), rinsing (20s), air drying (10s) and self-adhesive flowable composite-resin. Sealed teeth were thermocycled (500 cycles, 5–55ºC) and immersed on ammoniacal silver nitrate solution for 24 hours (ph = 14). After that, the teeth were immersed on radiographic developer solution (GBX, Kodak) for 8 hours. Then, teeth were vertically sectioned to obtain two slides each that were observed under magnification (4x) and digitally analyzed to assess microleakage and sealant penetration. Results were statistically analyzed (Kruskal-Wallis, Tukey’s, p < 0.05).

Results: Microleakage of Group 1 (13.18 ± 9.25%) was significantly lower than groups 2, 3 and 4 (p < 0.05). Microleakage of Group 2 (87.87 ± 11.76%) was significantly lower than groups 3 and 4 (p < 0.05). Group 1 had the highest sealant penetration mean (98.92 ± 2.77%). No significant differences were found between groups 2, 3 and 4 (p > 0.05) for sealant penetration.

Conclusions: Fusio Liquid Dentin had a worse sealing ability than Clinpro irrespective of their enamel surface treatment when it is used as a fissure sealant. Between Fusio’s groups, acid etching was the best enamel surface treatment.

3M ESPE Summary

Aim of Study: This study was designed to measure enamel microleakage of a self-adhesive flowable composite against a pit and fissure sealant applied using the recommended instructions for use (acid etch, rinse and dry).

Summary of Results: The pit and fissure sealant (Clinpro Sealant), applied using the recommended instructions for use, showed statistically significantly lower microleakage than did the self-adhesive flowable composite no matter how the substrate was prepared.
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Based on the data contained in the abstracts, 3M ESPE has provided graphics, “Aim of the Study” and “Results of the Study” to visualize and summarize the results.