2009 Espertise

Scientific Facts

87th General Session & Exhibition of the IADR
38th Annual Meeting of the AADR
33rd Annual Meeting of the CADR
PEF September 10–12, 2008
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Welcome

It is our great pleasure to welcome you to the 87th General Session of the IADR. Our staff cordially invites you to visit our 3M ESPE Hospitality Center (Hall D) to meet representatives from the many parts of our oral care business.

Our goal is to provide you with knowledge you can use and information you can trust. Therefore, we will not only be offering you a selection of Expertise™ scientific and technical resources as we’ve done in years past, we will also host our first “Meet the Experts” sessions. These sessions will give you the chance to hear presentations specific to a few of our core technologies including:

- Benchmark in Low Shrinkage and Stress—Siloranes
- Advances from the Worldwide Leader in Impression Solutions
- Nanotechnology
- Role of Calcium Phosphates in Demineralization & Remineralization
- Lava™ Chairside Oral Scanner (C.O.S.)

We hope you will enjoy the information, engage our product developers in lively discussion, and develop a better understanding of our technologies, products and innovative culture.

This collection of Scientific Facts includes abstracts which have been published as originally submitted by the author, as well as additional graphics, “Aim of the Study” and “Results of the Study” summaries. At the end of the Direct and Indirect Restorative sections you will also find more than 200 references, all featuring 3M ESPE products, for your review.

Impression Materials and Digital Impressions

As the market leader in impression materials, we provide excellent material and handling properties for both our polyether and VPS impression materials. We also have a new mixing device. The Pentamix™ 3 Automatic Mixing Unit offers a faster and more homogenous mix compared to hand mixed materials including putty. Other studies of interest highlight the new Impregum™ Soft Tray Impression Material which has been proven to provide a better and more stable flow (even when compared to VPS) throughout the materials’ working time. These flow characteristics are just one of the reasons for the continued popularity of polyether impression materials. For the vinyl polysiloxane category, Imprint™ 3 VPS Impression Material has been shown to have very high tear strength which is critical in the “thin” areas of an impression especially in the hard to reach sulcus.

Given all of our experience in the area of impressions and impression materials, 3M ESPE is an ideal partner as you consider the exciting new world of digital dentistry. We are pleased to publish scientific data on the new Lava C.O.S. including an \textit{in vitro} study where Lava C.O.S. demonstrated dimensional repeatability for single preparations that is beyond the requirement to achieve clinical acceptability for marginal adaptation in crown or bridge restorations.

Cements and Provisional Products

RelyX™ Unicem Self-Adhesive Universal Resin Cement was the first available self-adhesive resin cement and has enjoyed six years of commercial success. Given the depth and breadth of studies supporting RelyX Unicem cement, it is now considered the gold standard in the self-adhesive resin cement category. The abstracts presented in the coming pages emphasize the advantages this clinically proven material...
provides including superior adhesion (including to zirconia oxide ceramics), and ease of use in difficult clinical situations. We have also included a 2-year clinical report for RelyX™ Fiber Post, a product which perfectly complements RelyX Unicem cement.

We have also highlighted our provisional materials, specifically, our Protemp™ 4 Temporization Material which is a bis-acrylic temporary crown and bridge material. This new composite-based temporary material demonstrates the highest fracture resistance available in its category as confirmed in a chewing simulation study as well as outstanding esthetics. Profilometry data also supports our assertion that this material often requires no polish.

Lab and Digital Products

CAD/CAM technology has made it possible to create very high strength ceramic restorations. With the introduction of zirconia to dentistry, clinicians are able to place all-ceramic restorations in a broad range of anterior and posterior indications. While several companies offer zirconia blocks or discs that are often quite similar in their chemical composition, they are not necessarily the same. Differences in performance and esthetics are evident for a variety of reasons including raw material quality, blank processing and pre-sintering, gluing and milling, as well as shading and final sintering processes. In this issue of Expertise™ Scientific Facts, you will find data demonstrating the excellent characteristics of Lava™ Crowns and Bridges. We will also highlight our new digital veneering system Lava DVS which provides better esthetics and higher productivity compared to pressed veneer systems. We’re also pleased to give you more information about the Lava authentication program, the new Lava CNC 500 milling system and our selective open architecture approach.

Direct Restorative Products

Our market leading position in composites is also reflected in our 2009 restorative abstracts. Filtek™ Silorane Low Shrink Posterior Restorative was introduced as a completely new type of composite—with breakthrough minimal polymerization shrinkage and stress. As a result, data found in this collection of abstracts shows excellent marginal performance, the lowest cuspal deflections among composites tested, and excellent clinical performance. The Filtek Silorane adhesive system shows similar performance compared to high quality 2-step self-etch systems. The first in vivo studies confirm the positive clinical performance of the Filtek Silorane system.

You will also find several in vivo reports which study the performance of our 3M ESPE adhesive portfolio. The clinical documentation covers both our total-etch adhesives (Adper™ Single Bond) and our self-etch adhesives (Adper™ Scotchbond™ SE and Adper™ Prompt L-Pop) in studies on both anterior and posterior restorations which include pediatric and adult patients.

We would also like to call attention to our state-of-the-art curing device, which was designed to deliver reliable clinical performance for our light cured materials. The latest LED device, the Elipar™ S10, features high intensity on a large illuminated surface combined with more focused light output, which results in a faster, better depth of cure. The unique ergonomics and one-piece stainless steel design make the light robust and comfortable to use.

Text and graphics above refer to branded products offered by various companies. For trademark information, see the back page of this brochure.

Reprinted with permission from the Journal of Dental Research, Vol. 88, Special Issue A, 2009,
While not always in the spotlight, you will also find several in vivo studies featuring our glass ionomer products. As a category, glass ionomers have an excellent track record for performance and ease of use. Traditional indications, ART (atraumatic restorative treatment) and “press finger” occlusal sealant techniques are featured.

Preventive Products

3M ESPE Preventive Care provides patients with innovative and differentiating solutions to help prevent oral disease and improve overall oral health. The latest developments include Clinpro 5000 1.1% Sodium Fluoride Anti-Cavity Toothpaste and Vanish™ XT Extended Contact Varnish. Clinpro 5000 is an anti-cavity toothpaste indicated for use as part of a professional program for the prevention and control of dental caries. Vanish XT is a site-specific, durable protective coating for the treatment of exposed root surfaces to relieve sensitivity and also serves as a site-specific protective coating for newly erupted teeth and other tooth surfaces (e.g. around orthodontic brackets and acid erosion) including non-cavitated lesions. You will find research on these two new products as well as additional research on our market-leading varnish, Vanish 5% NaF White Varnish, in the last chapter of this booklet.

Our goal remains to provide practical and ingenious solutions that help you succeed. At this point, we want to thank and congratulate the renowned universities and scientific institutions for their excellent work which is contained in the abstracts herein.

Sincerely,

Bethua Richter
Head of Global Scientific Marketing
St. Paul, MN and Seefeld, Germany
April 2009
Flow Behaviour of Hand Dispensed Impression Materials at Different Amounts
L. TRAN, Q. BUI, R. PERRY, G. KUGEL, and P. STARK, Tufts University, Boston, MA

Objective: The purpose of this study was to compare the flow behaviour of hand dispensed impression materials at the pre-determined end of tray filling time of 19 ml, 30 ml, and 46 ml trays and at the manufacture’s suggested end of working time (EWT).

Methods: A 2 mm slit shark-fin device (#3048 IADR 2005) with a standard force of 415 g was applied to four impression materials (sixteen groups, N=5) [Aquasil Ultra Heavy SS (A1, Dentsply), Flexitime Monophase (F1, Heraeus-Kulzer), Genie Regular Body Rapid (G1, Sultan), and Impregum Soft Quick (I1, 3M ESPE)] to measure the flow at the pre-determined end of tray filling time of 19 ml, 30 ml, and 46 ml trays and at the manufacture’s suggested end of working time (EWT). Five minutes after the start of the mix, the device was disassembled and the height of the shark fin was measured.

Results: The average heights of the shark-fins were statistically analyzed by ONE-WAY ANOVA with Fisher Test and TWO-WAY ANOVA (p<0.05).

<table>
<thead>
<tr>
<th></th>
<th>19 ml</th>
<th>13 ml</th>
<th>46 ml</th>
<th>EWT</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Ht</td>
<td>SD</td>
<td>Rank*</td>
<td>Ht</td>
</tr>
<tr>
<td>A1</td>
<td>11 mm</td>
<td>0.4</td>
<td>C</td>
<td>8 mm</td>
</tr>
<tr>
<td>F1</td>
<td>9 mm</td>
<td>0.8</td>
<td>D</td>
<td>7 mm</td>
</tr>
<tr>
<td>G1</td>
<td>18 mm</td>
<td>0.7</td>
<td>B</td>
<td>17 mm</td>
</tr>
<tr>
<td>I1</td>
<td>25 mm</td>
<td>0.6</td>
<td>A</td>
<td>24 mm</td>
</tr>
</tbody>
</table>

*Same letters indicates no significant difference (p<0.05) within the same column.

Conclusions: Impregum Penta polyether exhibited the more stable flow compared to the other tested materials at all tray sizes and EWT. This may have clinical benefits for more accurate impression, more testing needed. Sponsored in part by 3M ESPE.

3M ESPE Summary

Aim of the study: The purpose of this study was to compare the flow behavior of hand dispensed impression materials at the pre-determined end of tray filling time of different tray sizes (19 ml, 30 ml, and 46 ml) and at the manufacture’s suggested end of working time using a 2 mm slit shark-fin device (#3048 IADR 2005) with a standard force of 415 g. A new cartridge delivered polyether tray material Impregum™ Soft Quick Step Polyether Impression Material (3M ESPE) and the three PVS materials Aquasil Ultra Heavy (Dentsply), Flexitime Monophase (Heraeus-Kulzer), and Genie Regular Body Rapid (Sultan) were investigated.

Results of the study: Impregum Soft quick step polyether impression material showed higher and more stable flow compared to the other tested materials which may have clinical benefits for more accurate impression.

R. PERRY, L. TRAN, Q. BUI, G. KUGEL, and P. STARK, Tufts University, Boston, MA

Objective: To compare flow behaviour of hand-dispensed vs. auto-mixed impression materials by measuring the flow at a pre-determined average tray filling time (Initial) of a 19 ml tray and at the manufacturers’ suggested end of working time (EWT) for each set of materials.

Methods: A 2 mm slit shark-fin device (#3048 IADR 2005) with a standard force of 415 g was applied at Initial and EWT phases to measure flow of the six different materials (N=5). Five minutes after start of mix, the device was disassembled and the height of the shark fin was measured.

<table>
<thead>
<tr>
<th>Impression Material</th>
<th>Hand-Dispensed Type</th>
<th>Auto-Mixed Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aquasil Ultra Heavy Fast Set (A1, Dentsply)</td>
<td>PVS</td>
<td>Aquasil Ultra Heavy Fast Set Deca (A2, Dentsply)</td>
</tr>
<tr>
<td>Flexitime Monophase (F1, Heraeus-Kulzer)</td>
<td>PVS</td>
<td>Flexitime Dynamix Monophase (F2, Heraeus-Kulzer)</td>
</tr>
<tr>
<td>Impregum Soft Quick (I1, 3M ESPE) Polyether</td>
<td>Impregum Penta Soft Quick Medium (I2, 3M ESPE) Polyether</td>
<td></td>
</tr>
</tbody>
</table>

Results: Average heights of the shark-fins were statistically analyzed by ONE-WAY ANOVA with Fisher Test and TWO-WAY ANOVA (p<0.05).

<table>
<thead>
<tr>
<th></th>
<th>Initial</th>
<th></th>
<th>EWT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Height</td>
<td>Std Dev</td>
<td>Ranking</td>
<td>Height</td>
</tr>
<tr>
<td>A1</td>
<td>11 mm</td>
<td>0.4</td>
<td>*C</td>
</tr>
<tr>
<td>A2</td>
<td>13 mm</td>
<td>0.5</td>
<td>*B</td>
</tr>
<tr>
<td>F1</td>
<td>9 mm</td>
<td>0.5</td>
<td>CD</td>
</tr>
<tr>
<td>F2</td>
<td>9 mm</td>
<td>0.5</td>
<td>D</td>
</tr>
<tr>
<td>I1</td>
<td>25 mm</td>
<td>0.6</td>
<td>A</td>
</tr>
<tr>
<td>I2</td>
<td>24 mm</td>
<td>0.7</td>
<td>A</td>
</tr>
</tbody>
</table>

*Asterisk indicates a significant difference within the same label between hand-dispensed and auto-mixed. The same letters under “ranking” are not significantly different (p>0.5) within the same column.

Conclusions: Each material showed a significant difference between hand-mixed and auto-mixed at either Initial or EWT. However, the height of the shark-fin appears more significant when comparing polyether vs. PVS. Impregum (I1 and I2) showed higher flow characteristics compared to the other materials tested. Further test deems necessary. Sponsored in part by 3M ESPE.

3M ESPE Summary

Aim of the study: The shark fin test was used [2 mm slit shark-fin device (#3048 IADR 2005) with a standard force of 415 g] to compare the flow behaviour of hand-dispensed vs. automated-mixed impression materials by measuring the flow at a pre-determined average tray filling time and at the manufacturers’ suggested end of working time for each set of materials: Impregum™ Soft Quick Step/Impregum™ Penta™ Soft Polyether Impression Material, Aquasil Ultra Heavy Fast Set/Aquasil Ultra Heavy Fast Quick Step, Set Deca, Flexitime Monophase/Flexitime Dynamix Monophase.

Results of the study: Impregum polyether material showed superior flow for both hand-dispensed as well as automated-mixed materials.
Objectives: To assess the dimensional stability of eight impression materials over 12 weeks.

Methods: Ten impressions from each material were taken of a metal block which conformed to the American Dental Association (ADA) specification No. 19 for elastomeric impression materials. In addition, 5 impressions were taken of another metal standard block containing vertical features allowing measurements over three coordinates. Impressions were scanned on a non-contacting laser profilometer (Taicaan™—Southampton, UK); using surface metrology software Boddies® (Taicaan™—Southampton, UK) measurements were made at 24 hours, 2, 4, 8 and 12 weeks. The impression materials tested were [1] Aquasil™, [2] Aquasil™ DECA, [3] Affinis™, [4] Express™, [5] Extrude™, [6] Impregum™ Penta Soft Polyether [7] President™ and [8] Take 1™.

Results: Seven addition silicones and one polyether ([6]) impression material were tested. [2] and [6] were monophasic, the rest were putty-wash. The results from the ADA metal block showed statistically significant differences in measurements indicating that [1] expanded by a mean 40 µm at 2 weeks; [2] expanded by a mean 30 µm at 2 weeks and that [4] expanded by a mean 40 µm at 2 weeks. All other materials showed no changes (ANOVA p<0.05). The results from the metal block indicated that [3] contracted by a mean 60 µm at 4 weeks; [4] expanded by a mean 70 µm at 2 weeks; [5] expanded by a mean 160 µm at 2 weeks; [6] contracted by a mean 90 µm at 2 weeks; [7] expanded by a mean 85 µm at 2 weeks and [8] contracted by a mean 90 µm at 2 weeks. All other materials showed no changes (ANOVA p<0.05).

Conclusion: All materials met the manufacturers claim to be dimensionally stable up to 2 weeks. This study was supported by the Guy’s and St Thomas’ Charity Grant No. G050202.

3M ESPE Summary

Aim of the study: The dimensional stability over 12 weeks of eight impression materials including Impregum™ Penta™ Soft Polyether Impression Material and Express was assessed using a non-contacting laser profilometer.

Results of the study: All materials met the manufacturers claim to be dimensionally stable up to 2 weeks.
Axial Notch Tear Strength of Elastomeric Impression Materials

A. BOGHOSIAN, and E. LAUTENSCHLAGER, Northwestern University, Chicago, IL

Marginal tearing of an elastomer reduces the accuracy of the impression.

Objectives: The purpose of this study was to determine the tear strength of various elastomeric impression materials.

Methods: Ten materials were tested: Affinis Precious Regular and Light Body (Coltene/Whaledent), Aquasil Ultra XLV and LV Fast Set (Caulk), Imprint™ 3 Quick Step Light and Regular Body, Impregum Soft Quick Step Light Body, Impregum Penta Soft Quick Step (3M ESPE), Take 1 Advanced LB and RB Super Fast Set Wash (Kerr). Five axial notch specimens, measuring 4” x 0.75” x 0.0090”, were made in a proprietary stainless steel injection mold. The mold was filled with impression material, sealed, and immediately placed in a water bath at 35˚C. At the manufacturer’s recommended mouth removal time, the mold was retrieved from the water bath. The specimens were gripped over the first inch from either end leaving 2 inches of gage length and continuously loaded on an Instron testing machine at a crosshead speed of 10 inch/minute until failure occurred. The data was statistically analyzed using ANOVA and post-hoc testing of means by the Fisher LSD test (p≤0.05). Letters (a–e) denote statistically significant differences between the groups.

Results:

<table>
<thead>
<tr>
<th>Impression Material</th>
<th>Tear Strength (Psi)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Imprint 3 Quick Step Regular</td>
<td>728.39 ± 42.31a</td>
</tr>
<tr>
<td>Aquasil Ultra LV Fast Set</td>
<td>646.03 ± 51.60b</td>
</tr>
<tr>
<td>Affinis Precious Regular</td>
<td>640.60 ± 43.59b</td>
</tr>
<tr>
<td>Imprint 3 Quick Step Light</td>
<td>612.50 ± 8.85c</td>
</tr>
<tr>
<td>Aquasil Ultra XLV Fast Set</td>
<td>605.97 ± 46.45c</td>
</tr>
<tr>
<td>Affinis Precious Light</td>
<td>524.93 ± 53.07c</td>
</tr>
<tr>
<td>Impregum Penta Soft Quick Step</td>
<td>366.48 ± 15.37c</td>
</tr>
<tr>
<td>Take 1 Advanced RB Super Fast</td>
<td>365.31 ± 67.61d</td>
</tr>
<tr>
<td>Take 1 Advanced LB Super Fast</td>
<td>316.88 ± 37.50d</td>
</tr>
<tr>
<td>Impregum Soft Quick Step Light</td>
<td>217.06 ± 17.91e</td>
</tr>
</tbody>
</table>

Conclusion: Resistance to marginal tearing may be affected due to significant differences in the tear strength of elastomeric impression materials.

3M ESPE Summary

Aim of the study: The purpose of this study was to determine the tear strength of the following elastomeric impression materials: Affinis Precious Regular and Light Body (Coltene/Whaledent), Aquasil Ultra XLV and LV Fast Set (Caulk), Imprint™ 3 Quick Step Light and Regular Body, Impregum™ Soft Quick Step Light Body, Impregum™ Penta Soft Quick Step (3M ESPE), Take 1 Advanced LB and RB Super Fast Set Wash (Kerr).

Results of the study: Imprint 3 Quick Step Regular Body showed significantly higher tear strength than all other products tested. Also Imprint 3 Quick Step Light Body displayed very high tear strength.
Mixing Quality of Hand and Dynamic Mixed Putty Impression Materials

T. KLETTKE, J. KERN, and J. GRAMANN, 3M ESPE, Seefeld, Germany

Objectives: One distinctive requirement of dental impression materials consisting of two components (base and catalyst) is the homogeneity of their mixture. Only a homogenous mix guarantees the material properties necessary for precise impressions. The goal of this study is to compare the mixing quality achieved with hand mixing vs. automated mixing using the Pentamix 3 (3M ESPE) device.

Methods: Two materials with the same color (“burnt orange”) were compared: Express Putty STD, EPS (hand mix, 3M ESPE) and Express 3 Penta Putty Soft, EPPS (dynamic mix, 3M ESPE).

Three people generated three samples of mixed EPS (30 second mix according to the instructions for use). Three comparative samples of EPPS were generated using the Pentamix 3. All samples were investigated twice using a spectrometer (Ocean Optics, S2000) and a lens system enabling a spatial resolution of 0.1 mm after setting. The samples were moved in the focus of the lens system on a zigzag course in an area of 2 × 8 mm by two linear axes. During the movement, the a-value of the Lab color system was recorded by a data logger. The standard deviation of the a-value of each sample is used as the metric for mixing quality.

Results: The standard deviation for the color value for each group of samples was (mean, SD in brackets): EPS: 2.536 (1.808) and EPPS: 0.227 (0.012). As shown by ANOVA (p<0.05) the standard deviation of the color value of EPS is significantly higher than that of EPPS.

Conclusions: When comparing the deviation of the color value, the products tested showed a more homogenous mix after dynamic mixing (EPPS) as compared to hand mixing (EPS).

3M ESPE Summary

Aim of the study: To compare the mixing quality of impression material achieved with hand mixing (Express STD) vs. automated mixing (Express™ 2 Penta Putty Soft) using the Pentamix™ 3 Mixing Unit (3M ESPE).

Results of the study: The product Express 2 Penta Putty Soft mixed with the Pentamix 3 mixing unit showed a more homogenous mix as compared to the hand mixed Express STD.
Morphological Characterization of a New Temporary Crown and Bridge Material

A. SEZINANDO, University of Lisbon, Lisboa, Portugal, and J. PERDIGAO, University of Minnesota, Minneapolis, MN

Objectives: To characterize the ultra-morphology (AFM, FESEM) and surface characteristics (Profilometry) of four bis-acryl composite resins for provisional fixed restorations.

Methods: Materials: (1) Integrity Fluorescence (INT, Dentsply); (2) Luxatemp Fluorescence (LUX, DMG); (3) Protemp Plus (PRP, 3M ESPE); and (4) Structur Premium (STP, Voco). AFM/FESEM—three unpolished disks from each material were fabricated; three AFM readings were taken randomly from each specimen, same magnification. The specimens were coated with Au-Pd and observed under a FESEM (X5,000–X50,000). Nanoprobe Profilometer—three unpolished and three polished (Sof-Lex XT, 3M ESPE) specimens from each material were analyzed with the Nanoprobe Profilometer in three different areas of each specimen. Separate statistical analyses (ANOVA, Duncan’s, p<0.05) for polished/unpolished specimens were computed with SPSS14.0 (SPSS Inc).

Results: AFM—Surface topography of PRP was distinct from the other materials. Smooth surfaces were observed consistently across the PRP specimens as opposed to the irregular topography for the other materials; FESEM—The morphology of INT and LUX was similar, showing filler particles up to 3 µm-wide with empty areas resulting from detachment of filler particles and gaps at the interface between the particle and the surrounding matrix. For STP, the biggest particle size was under 2 µm, with areas displaying clustered microfiller particles. For PRP, the particle size resembled that of a nanofilled composite (20–30 nm), with dispersed spherical particles in the range of 40–50 nm. Profilometry (nm)—For polished specimens, PRP resulted in the lowest roughness (0.86 × 103) which was significantly lower than the other materials (INT–1.60 × 103; LUX–1.36 × 103; STP–1.90 × 103). The pairs LUX/INT and INT/STP ranked in the same subset. For unpolished specimens, INT (7.51 × 103) resulted in significantly greater roughness than the other materials. PRP resulted in the lowest roughness (1.27 × 103).

Conclusion: PRP resulted in smoother morphology than the other 3 materials. Supported by 3M ESPE.

3M ESPE Summary

Aim of the study: To compare surface properties of leading provisional crown and bridge materials including the newly launched Protemp™ 4 Temporization Material with different methods (Profilometer, AFM, FESEM).

Results of the study: Protemp 4 temporization material has smoother surface than other provisional crown and bridge materials without polishing.
Color Stability of Composite Based Temporary Crown and Bridge Materials

S. HADER, U. HOHEISEL, R. HECHT, and C. THALACKER, 3M ESPE AG, Seefeld, Germany

Objectives: To compare color stability of composite based crown and bridge materials with regard to exogenic staining against coffee and red wine.

Methods: Test samples (diameter: 20 mm, height: 3.5 mm) for coffee test (n=3) and red wine test (n=6) were fabricated from each material and cured for 1 hour against glass plates at room temperature. The inhibition layer was removed with alcohol. Cielab L’, a’ and b’ values were determined by using Hunterlab Labscan Spectrocolorimeter (aperture: 12 mm; measuring field: 12 mm). Then the test samples were immersed in coffee (extract of 200 g coffee with 1,000 ml boiling water) and red wine for 72 hours at 36˚C. After removal test samples were rinsed with water and cleaned with a toothbrush for 30 seconds on each side. Cielab L’, a’ and b’ values were determined again and the discoloration dE* was calculated. Descriptive statistics were performed by using one way ANOVA with a Fisher test and a confidence interval of 95%. Results including standard deviations (STD) are summarized in the table below.

Results

<table>
<thead>
<tr>
<th>Material</th>
<th>Red Wine</th>
<th>Coffee</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>dE* (STD)</td>
<td>dE* (STD)</td>
</tr>
<tr>
<td>New Protemp</td>
<td>3.13 (0.27)a</td>
<td>3.70 (0.28)a</td>
</tr>
<tr>
<td>Structur Premium</td>
<td>5.92 (0.42)b</td>
<td>5.29 (0.67)b</td>
</tr>
<tr>
<td>Luxatemp Fluorescence</td>
<td>3.73 (0.35)b</td>
<td>7.99 (0.53)c</td>
</tr>
<tr>
<td>Integrity Fluorescence</td>
<td>3.73 (0.27)b</td>
<td>7.61 (0.42)c,d</td>
</tr>
<tr>
<td>Kanitemp Royal</td>
<td>5.26 (0.23)c</td>
<td>9.11 (0.69)c</td>
</tr>
</tbody>
</table>

New Protemp showed the best color stability over time in this in vitro test set up with coffee or red wine staining solutions.

Conclusions: These results are an indicator that New Protemp with its improved surface properties has significantly better color stability than other composite based crown and bridge materials and will be able to meet increasing aesthetic customer needs.

3M ESPE Summary

Aim of the study: To compare stain resistance of leading temporary crown and bridge materials against coffee and red wine.

Results of the study: Protemp™ 4/Protemp™ Plus (New Protemp) temporization material demonstrates significantly improved stain resistance in this in vitro set up.

Text and graphics above refer to branded products offered by various companies. For trademark information, see the back page of this brochure.

Protemp™ 4 Temporization Material

Smear Layers Thickness of Temporary Materials Against Air and PVS
O.N.T. BUI, L. TRAN, R. PERRY, G. KUGEL, and P. STARK, Tufts University, Boston, MA

Objective: Determine the thickness of the residual smear layers of automixed-temporary materials against air and impression materials.

Methods: Twenty-four groups (N=6) were selected to test for the thickness of smear layers against air or against PVS impression materials [Position Penta Quick (PPQ, 3M ESPE), Express 2 Penta Putty (E2P, 3M ESPE)]. Eight temporary crown and bridge materials were Protemp Plus (PP, 3M ESPE), Luxatemp Automix (LA, DMG), Luxatemp Fluorescence (LF, DMG), Integrity Fluorescence (IF, Dentsply), Kaniteemp Royal (KR, Kaniedenta), Structur Premium (SP, VOCO), Structur 2 SC (S2, VOCO), Acrytemp (AC, Zhermack).

Each material was placed in Delrin-rings (d=20 mm; h=3.5 mm) closed with glass plates on one side. The opposite side was either against air, PPQ or E2P. Specimens were removed after they were cured for 15 minutes at 23°C. Initial weighting (M1) was determined from the specimens after curing. Second weighting (M2) was determined after the specimens were cleaned with alcohol. In the case of impression materials, the impression plates were also weighted before and after materials were cured.

Results: Data was analyzed using One-way ANOVA with Fischer test, and a confidence interval of 95%. Summary of results and mean values including standard deviations (in bracket) were calculated. Fischer test reveals that there were significant different between PP and all other groups against air and E2P. However, there was a significant between PP and all other groups against PPQ, except to LF.

<table>
<thead>
<tr>
<th>Material</th>
<th>Air [mg/cm²]</th>
<th>PPQ [mg/cm²]</th>
<th>E2P [mg/cm²]</th>
</tr>
</thead>
<tbody>
<tr>
<td>PP</td>
<td>3.05 [0.08]</td>
<td>1.35 [0.09]</td>
<td>0.50 [0.16]</td>
</tr>
<tr>
<td>LA</td>
<td>3.45 [0.18]</td>
<td>2.06 [0.30]</td>
<td>1.24 [0.18]</td>
</tr>
<tr>
<td>LF</td>
<td>3.62 [0.19]</td>
<td>1.63 [0.17]</td>
<td>1.01 [0.12]</td>
</tr>
<tr>
<td>IF</td>
<td>3.87 [0.16]</td>
<td>1.80 [0.12]</td>
<td>1.15 [0.18]</td>
</tr>
<tr>
<td>KR</td>
<td>4.69 [0.26]</td>
<td>2.40 [0.23]</td>
<td>1.61 [0.17]</td>
</tr>
<tr>
<td>SP</td>
<td>6.34 [2.10]</td>
<td>3.42 [0.17]</td>
<td>2.61 [0.35]</td>
</tr>
<tr>
<td>S2</td>
<td>6.62 [3.90]</td>
<td>3.67 [0.30]</td>
<td>2.60 [0.23]</td>
</tr>
<tr>
<td>AC</td>
<td>8.01 [0.17]</td>
<td>5.54 [0.71]</td>
<td>3.70 [0.43]</td>
</tr>
</tbody>
</table>

*Same letter indicates no significant difference within the same column (a, b, c, d, e, f).

Conclusion: Protemp Plus shows less smear layer compared to all other materials either against air or impression materials. The thicknesses of smear layers were lower against the impression materials than against air, which may be beneficial in the clinical situation.

Sponsored in part by 3M ESPE.

3M ESPE Summary

Aim of the study: Comparison of the thickness of the inhibition layers of new Protemp™ Plus/Protemp™ 4 Temporization Material vs. other leading provisional crown and bridge materials.

Results of the study: The inhibition layers of all materials tested were lower against silicone impression materials than against air. Lowest inhibition layers were seen for Protemp Plus/Protemp 4 temporization material.
Fracture Performance of Provisional Crown & Bridge Restoration Materials

M. ROSENTRITT, R. LANG, M. BEHR, and G. HANDEL, Regensburg University Medical Center, Germany

Objectives: High strength of modern provisional materials is important for extending the time for clinical application. It was the aim of this study to determine fracture resistance and fracture toughness of different provisional restorative materials including an experimental product.

Methods: In this in-vitro study fracture strength of three-unit bridges of provisional crown & bridge materials was determined. Identical alloy dyes (Biosil F, DeguDent, G) were fixed in resin at a distance of 10 mm simulating a posterior gap. An artificial periodontium was provided with polyether impression material (Impregum, 3M ESPE, USA). All bridges were bonded with RelyX Temp NE Temporary Cement (3M ESPE, USA). Ten samples of each group were stored in aqua dist. for 14 days and subsequently submitted to thermal-cycling and mechanical-loading (TCML: 50 N, 48,0000 loadings; 1200x5’/55˚ C). Occlusal wear was determined with 3D scanning. Ten samples of each material were stored for 24 hrs in aqua dist. as a control. All specimens were loaded to fracture (Zwick, G; v=1 mm/ min). Fracture patterns were determined optically. Independently fracture toughness K1c was determined (n=10). Medians and 25%/75% percentiles were calculated. Statistics: Mann-Whitney-U-Test (α=0.05).

<table>
<thead>
<tr>
<th>Materials</th>
<th>Fracture Force [N] (24 hrs H2O storage)</th>
<th>Fracture Force [N] (14 days H2O storage +TCML)</th>
<th>K1c [MPa*m^1/2]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Luxatemp Fluorescence (DMG, G)</td>
<td>1006 (749/1237)</td>
<td>875 (771/1006)</td>
<td>0.89 (0.84/0.95)</td>
</tr>
<tr>
<td>Integrity Fluorescence (Dentsply,G)</td>
<td>897 (630/1159)</td>
<td>798 (718/897)</td>
<td>0.94 (0.80/0.99)</td>
</tr>
<tr>
<td>Structur Premium (Voco, G)</td>
<td>946 (858/1130)</td>
<td>820 (621/946)</td>
<td>1.07 (0.98/1.39)</td>
</tr>
<tr>
<td>Experimental Protemp (3M ESPE, USA)</td>
<td>1133 (909/1310)</td>
<td>920 (852/1133)</td>
<td>2.18 (1.92/2.40)</td>
</tr>
<tr>
<td>Acrytemp (Pluradent, USA)</td>
<td>740 (672/787)</td>
<td>(total failure)</td>
<td>1.66 (1.51/1.71)</td>
</tr>
</tbody>
</table>

Conclusions: The tested materials loose about 11–19% of their fracture strength due to TCML. One material even failed completely during aging. Among the surviving materials experimental Protemp Plus material showed the highest fracture resistance after TCML as well as highest fracture toughness and may be therefore considered for long-term temporization.

3M ESPE Summary

Aim of the study: To determine fracture resistance of 3-unit bridges in a thermocycling—mechanical loading (TCML) in vitro set up simulating 2 years of clinical use as well as in K1c fracture toughness test.

Results of the study: Protemp™ 3/Protemp™ Plus (Experimental Protemp) showed the highest fracture resistance before and after TCML compared to leading provisional crown and bridge materials. It can be recommended for long term temporization.
Primary Stainless Steel Crowns

Pulpotomy and Stainless Steel Crowns: Ratios in ECC
L. DIVITO, C. SEIGAL, S. THIKKURISSY, and P. CASAMASSIMO, Ohio State University, Columbus, OH

Objective: The purpose of this study was to evaluate a high volume pediatric practice and assess the ratio of pulpotomized teeth per stainless steel crowns and any predictive factors.

Methods: This retrospective chart review was done by three calibrated reviewers using a standardized radiographic index. Pre-treatment radiographs were assessed to extent of decay. Ratios were also assessed by provider type (faculty or resident) and treatment setting (general anesthesia or clinic setting).

Results: A total of 575 stainless steel crowns from 272 patients were reviewed. 61% of all children had at least one chronic health condition with asthma being the most common (21%). Overall, a total of 224 pulpotomies were noted giving a ratio of one pulpotomy for every 2.6 stainless steel crowns (38.9%). Teeth with radiographic scores of 0 (no radiographic caries), one (radiographic caries in outer enamel) and two (radiographic caries in inner enamel) had an overall ratio of 1:11, while teeth with radiographic scores three (radiographic caries in dentin) and four (radiographic caries contacting pulp) had a ratio of 1:2.3. No difference by provider type either between groups (faculty vs. resident) or within groups was noted. There was no significant relationship between reported pain and treatment performed. When teeth scored three or four radiographically there were significantly more likely to have pulpotomy therapy (p<0.0001)

Conclusion: The results of this study fall well within national benchmarks for pulpotomy: stainless steel crown ratio. Radiographic extent of decay was a significant predictor of treatment.

3M ESPE Summary

Aim of the study: To determine the ratio of pulpotomized teeth for stainless steel crown placement with regard to radiographic degree of tooth decay.

Results of the study: Significantly higher ratio of pulpotomies for extended radiographic decay reaching dentin or pulp versus other classifications.

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Clinical Performance of Fiber Post Restorations: 2-Year Results

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Objectives: To evaluate the 2-year outcome of post-retained restorations of endodontically treated teeth.

Methods: A consecutive sample of 45 patients was collected and 45 premolars (25 maxillary, 20 mandibular) were restored. RelyX Fiber posts (3M ESPE) were luted with RelyX Unicem (3M ESPE) following manufacturer’s instructions. Filtek Flow (3M ESPE) was used to build-up the abutment, that was covered with an all-ceramic crown (Empress II, Ivoclar-Vivadent). Baseline factors such as tooth type and number of residual coronal walls were noted. After 23–25 months patients were recalled and two operators who had been previously calibrated separately performed a clinical and radiographic examination. The following events were considered as failures: post debonding, post fracture, root fracture, failure of the core portion requiring a new coronal restoration, displacement of the crown, endodontic and periradicular conditions requiring endodontic retreatment. Kaplan-Meier plots were constructed. The Cox regression analysis was applied to assess the influence of baseline factors on failure occurrence.

Results: One patient could not be re-evaluated. Radiographic signs of periapical pathology were observed in three teeth, though symptoms were reported for only one of them. The three teeth showing periapical lesions also had the post debonded. Overall, four teeth with two residual coronal walls exhibited post debonding along with marginal leakage. All debonded posts were re-luted and the teeth were thus restored to function. The survival rate of post-retained restorations in this study was similar to the rates reported in previous clinical trials. The Cox regression analysis did not reveal any significant influence of baseline factors on failure occurrence.

Conclusions: Restorations of endodontically treated premolars retained by fiber posts luted with a self-adhesive resin cement showed a satisfactory success rate after 2 years of clinical service. All the four recorded failures consisted of post debonding, while no irreparable failures such as root fracture occurred.

3M ESPE Summary

Aim of the study: This clinical study evaluates the performance of RelyX™ Fiber Posts for restoring endodontically treated premolars.

Results of the study: The survival rate of the RelyX fiber post retained restorations corresponds to those reported in previous clinical trials. No catastrophic failures such as root fractures occurred.
Comparison of Different Mixing Methods of a Self-Etching Luting Composite

N. BARABANTI, F.J.T. BURKE, F. MANGANI, A. PUTIGNANO, G. MERLATI, and A. CERUTTI, 1University of Brescia, Brescia, Italy, 2University of Birmingham, Birmingham, United Kingdom, 3University of Rome - Tor Vergata, Rome, Italy, 4Polytechnic University of Marche, Ancona, Italy, 5Universita degli Studi di Pavia, Pavia, Italy

Introduction: The aim of this study is to evaluate the influence of different mixing-procedures and application methods of a self-etching-auto-luting composite on fiber post adaptation and adhesive-cementation quality.

Methods: Forty freshly extracted mono-radicular teeth (n=40) were endodontically treated and randomly divided into four groups. In all groups the same self-etching luting composite RelyX Unicem (3M ESPE) was used to adhesively lute the fiber posts (RelyX Fiber Post 3M ESPE). In group A we used RelyX Unicem Aplicap (3M ESPE, USA) mixed by an amalgam-vibrator then applied directly on the post, in Group B the cement was applied using the Elongation Tip into the root canal, in Group C RelyX Unicem Aplicap (3M ESPE, USA) was mixed by Rotomix and then directly applied into the root canal. In group D RelyX Unicem-Clicker (3M ESPE), following the manufacturer’s instructions for mixing, was applied using the Centrix system (Needle Tube 20 Ga). Teeth were then thermocycled according to the ISO/TR11405 protocol and immersed for 24-hours in a 2% methylene-blue solution. Each tooth was sectioned with a diamond-coated saw (Isomet-Buhler, Buffalo, NY, USA) from CEJ to apex to obtain 1 mm thick slices. Each slice was examined by means of stereoscopic microscopy (30X) for dye infiltration degree, the presence of gutta-percha remnants, voids and bubbles. Mann-Whitney and ANOVA statistical analysis (p<0.001) were performed for all results.

Results: No-statistical significances were evidenced for gutta-percha presence, dye-infiltration. Voids were present mostly in Group A. The difference was statistically significant and was due to the handling and positioning of the material. A significant reduction of microbubbles in group C and D using the mechanical mixer Rotomix was observed.

Conclusions: Materials and protocols for fibre-glass posts cementation are fundamental for the clinical success. Self adhesive luting cements, if used correctly, could be an acceptable and fast luting agent for post cementation.

3M ESPE Summary

Aim of the study: RelyX™ Fiber Posts were cemented with the self-adhesive resin cement RelyX™ Unicem Cement using different mixing devices and cementation techniques. Root canal sealing and presence of voids were evaluated.

Results of the study: The study proves that the selection of materials in combination with the correct procedure is crucial for the clinical success. RelyX fiber post, in combination with the self-adhesive resin cement RelyX Unicem cement, RelyX™ Elongation Tips and the 3M™ ESPE™ Rotomix™ Capsule Mixing Unit device represent a fast and successful solution for endodontic restorations.
Adhesion of Various Adhesive Resin Cements to Fiber Post

S. HADER, C.A. WIEDIG, B. LACHERMEIER, and R. PEEZ, 3M ESPE, Germany, Seefeld, Germany

Objectives: The purpose of this *in vitro* investigation was to evaluate the bond strength of self adhesive and adhesive resin cements to RelyX™ Fiber Post, a new glass fiber reinforced composite post (RLXFP, 3M ESPE).

Materials and methods: RelyX™ Unicem Aplicap™ self adhesive universal resin cement, (RXU, 3M ESPE), BisCem® (BIS, Bisco), G-CEM Capsule (GCM, GC), Maxcem™ (MC, Kerr) as well as Variolink® II (VAR) and Multilink® Automix (MUL, both from Ivoclar Vivadent) were used in combination with RLXFP (size 3). Except for MUL and VAR the fiberpost was not pre-treated. In case of MUL and VAR Monobond-S (MON, Ivoclar Vivadent) was used to silanize the post surface. Cements were light-cured (LC) or dark-cured (DC). Adhesion was tested on the conical part of the fiberposts and measured in a pull-off setup using an universal testing machine (Zwick Z010, crosshead speed 1 mm/min). Data obtained from the different groups were analyzed using ANOVA.

Results: The following table summarizes the mean adhesion values.

<table>
<thead>
<tr>
<th>Cement</th>
<th>RXU</th>
<th>BIS</th>
<th>GCM</th>
<th>MC</th>
<th>MON &amp; MUL</th>
<th>MON &amp; VAR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adhesion [MPa] LC</td>
<td>23.3±0.9</td>
<td>20.9±1.0</td>
<td>20.7±1.0</td>
<td>14.7±2.2</td>
<td>21.3±1.9</td>
<td>22.3±0.7</td>
</tr>
<tr>
<td>Adhesion [MPa] DC</td>
<td>23.1±1.9</td>
<td>21.1±3.3</td>
<td>20.4±1.6</td>
<td>13.0±1.5</td>
<td>16.6±1.3</td>
<td>not tested</td>
</tr>
</tbody>
</table>

Conclusions: RXU self adhesive universal resin cement showed best performance in both curing modes without any surface pre-treatment, whereas MON & MUL showed significantly lower bond strength when the dark cure mode was used. MC was found to have significantly lower bond strength in both curing modes.

3M ESPE Summary

**Aim of the study:** Compare the adhesive strength of different self-adhesive and conventional resin cements to fiber posts (RelyX).

**Result of the study:** RelyX Unicem self-adhesive universal resin cement showed highest adhesion without requiring an additional silanization step like conventional resin cements.
Retentive Strength of Zirconium-Oxide Crowns After Long Term Water Storage

C.-P. ERNST, A. SCHATTENBERG, C. BLUM, E. STENDER, and B. WILLERSHAUSEN, Johannes Gutenberg University, Mainz, Germany

Objectives: The retentive strength of a resin cement in combination with a new but conventional type adhesive (XP Bond-SCA-Calibra/DENTSPLY), five self-adhering cements (RelyX Unicem Aplicap, RelyX Unicem Clicker/3M ESPE, Maxcem/sds Kerr, Multilink Sprint/Ivoclar (2X), exp. cement/DENTSPLY), two glass ionomer-cements (Ketac Cem/3M ESPE, Meron/VOCO) and a resin modified glassionomer-cement (Meron Plus/VOCO) were examined for luting zircon-oxide ceramic crowns (LAVA, 3M ESPE) on extracted human teeth after thermocycling and one year of water storage.

Method: One hundred extracted teeth (n=10) were prepared in a standardized manner (10, hr=3 mm). 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 (Rocatec Pre). After thermocycling (5,000X, 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 out of Paladur denture base material) were removed along the path of insertion using a Zwick universal testing device. The retention surface was determined individually for each tooth (Dahl & Oilo, Dent Mater 2, 1986). Statistical analysis was made using the SPSS 11.0 program (Wilcoxon rank test, Bonferroni-adjustment).

Results: The retentive strength values [N/mm²] were (Min/Q1/Median/Q3/Max): RelyX Unicem Aplicap: 0.6/0.9/2.3/4.3/5.3 RelyX Unicem Clicker: 0.2/0.7/1.2/3.8/; Multilink Sprint—trial #1: 0.4/0.6/1.0/1.2/3; Multilink Sprint—trial #2: 0.0/0.1/0.2/0.6/1.2; Maxcem: 0.1/0.5/0.7/1.1/1.4; Exp. cement DENTSPLY: 0.0/0.2/0.6/1.0/2.1; Ketac Cem: 0.1/0.1/0.6/0.9/1.3; Meron: 0.4/0.5/1.2/1.6/2.2; Meron Plus: 0.2/0.7/1.2/3.0/3.1; XP Bond/SCA/Calibra: 0.4/1.1/3.2/3.4. RelyX Unicem Aplicap and XP Bond/SCA/Calibra both showed statistically significant higher median retentive strength values than Multilink Sprint (p<0.001)

Conclusion: RelyX Unicem showed the highest median retentive strength value. The group of self adhering cements showed retentive strength values compared to glass ionomer-cements.

This study was supported by Ivoclar Vivadent, 3M ESPE, VOCO, and DENTSPLY

3M ESPE Summary

Aim of the study: Eight luting materials ranging from glass ionomer to total etch conventional resin cement were compared regarding the retention of Lava™ Zirconia Crowns to human teeth after artificial aging.

Results of the study: In this clinically relevant test design, the self adhesive universal resin cement RelyX™ Unicem Resin Cement showed the highest median retentive force for sandblasted Lava zirconia crowns.
Bonding of FRC-Posts—Influence of Different Adhesive Cements and Localization

T.A. MACKERT1, A. PETSCHELT1, J.M. POWERS2, and C. BERTHOLD1, 1University of Erlangen-Nuremberg, Erlangen, Germany, 2University of Texas Dental Branch at Houston, Houston, TX, 3University of Erlangen, Erlangen, Germany

Objectives: The purpose of this study was to evaluate the influence for different adhesive luting systems and the influence of root canal region on bond strength of an adhesively luted glass-fiber-reinforced [FRC] posts.

Methods: Ninety extracted human single-rooted teeth were randomly assigned to nine groups (n=10), sectioned, root canals enlarged, post spaces (13 mm) prepared and posts (FRC-Postec, Ivoclar-Vivadent, Liechtenstein) bonded using nine adhesive luting systems (table) following manufacturers’ instructions. Roots were sectioned in five 1 mm slices and the bonding area was calculated by measuring slice thickness and post diameter. Section 1 was defined as coronal, section 3 as middle and section 5 as the apical root region. Micro-push-out test for these slices were performed; bond strength calculated and analyzed using ANOVA and LSD post-hoc test (p<0.001). The assessment of failure mode was made under a stereomicroscope.

Results: Significant lower bond strength was only found within group 3. Significant differences on bond strength, between coronal, middle and apical root region for each adhesive luting system were not detected.

<table>
<thead>
<tr>
<th>Group</th>
<th>Luting System</th>
<th>Mean Bond Strength (MPa)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>coronal</td>
</tr>
<tr>
<td>1</td>
<td>ED-Primer II_Panavia F2.0</td>
<td>15.0±6.1</td>
</tr>
<tr>
<td>2</td>
<td>AdheSE_Multicore flow</td>
<td>14.1±5.4</td>
</tr>
<tr>
<td>3</td>
<td>Syntac_Variolink II</td>
<td>5.3±2.8</td>
</tr>
<tr>
<td>4</td>
<td>Excite DSC_Variolink II</td>
<td>12.6±5.6</td>
</tr>
<tr>
<td>5</td>
<td>ED-Primer_Panavia 21</td>
<td>13.8±5.7</td>
</tr>
<tr>
<td>6</td>
<td>MultilinkPrimer_Multilink</td>
<td>11.5±3.4</td>
</tr>
<tr>
<td>7</td>
<td>ED Primer II_Clearfil Esthetic Cement</td>
<td>13.7±4.9</td>
</tr>
<tr>
<td>8</td>
<td>RelyX Unicem Self-Adhesive Universal Resin Cements</td>
<td>17.2±4.7</td>
</tr>
<tr>
<td>9</td>
<td>LuxaBond_LuxaCoreZ</td>
<td>15.7±5.8</td>
</tr>
</tbody>
</table>

Conclusion: Only one luting system influenced bond strength significantly. The lower bond strength values obtained, in this group might, be the result of an incomplete cure of the light-cured adhesive. The root canal region did not influence the bond strength.

3M ESPE Summary

Aim of the study: Comparison of nine different adhesive luting systems for cementation of fiber posts into human root canals. Different dentinal areas were investigated.

Results of study: The RelyX™ Unicem Self-Adhesive Resin Cement showed excellent adhesive performance for fiber post cementation and in contrast to the other materials tested required no additional pretreatment steps using primers and/or bonding agents.

Text and graphics above refer to branded products offered by various companies. For trademark information, see the back page of this brochure.


Results found in abstracts for RelyX™ Unicem Self-Adhesive Universal Resin Cement also apply to products registered under the following name(s): RelyX U100 Self-Adhesive Universal Resin Cement.
2-Year Clinical Effectiveness of a Self-Adhesive Luting Agent

M. PEUMANS, J. DE MUNCK, K. VAN LANDUYT, A. POITEVIN, P. LAMBRECHTS, and B. VAN MEERBEEK,
Leuven BIOMAT Research Cluster, Catholic University of Leuven, Belgium

Objectives: Among the materials used for luting indirect restorations, a growing interest has been directed towards the use of self-adhesive resin cements. The aim of this prospective randomized controlled clinical trial was to evaluate the 2-year clinical performance of the self-adhesive resin cement RelyX Unicem (3M ESPE, Seefeld, Germany) used for luting of ceramic inlays. In addition, the influence of selective acid-etching enamel prior to luting on the clinical performance of the restorations was assessed. The hypothesis tested was that there was no significant difference in clinical behaviour between restorations with (Etch) or without prior enamel acid-etching (Non-etch).

Methods: Sixty-two IPS Empress 2 inlays/onlays were placed in 31 patients by two experienced clinicians. The restorations were luted with RelyX Unicem with (=experimental group; Etch) or without (=control group; Non-etch) prior enamel etching with 35% phosphoric acid. At baseline, 6 months, 1 year and 2 years after placement, the restorations were assessed by two calibrated investigators using modified USPHS criteria.

Results: The recall rate at 24 months was 96.6%. Two restorations were clinically unacceptable due to loss of retention, leading to a survival rate of 96.6% (Kaplan-Meier). No significant difference was noted between the experimental group and the control group regarding marginal integrity, inlay integrity, tooth integrity, complications and sensitivity (McNemar, p>0.05). An obvious deterioration in marginal adaptation was observed after 24 months as only 21.7% (Etch=23.4%; Non-etch=20%) of the restorations exhibited an excellent marginal adaptation compared to 70.7% (Etch=75%; Non-etch=66.7%) at baseline. In 74.9% of the restorations, small (still clinically acceptable) marginal deficiencies were observed (Etch=76.6%; Non-etch=73.2%).

Conclusion: The self-adhesive resin cement RelyX Unicem showed an acceptable clinical behaviour after two years of clinical service. Selective enamel etching prior to luting had no significant influence on the clinical performance of the restorations after 24 months.

3M ESPE Summary

Aim of the study: This clinical study evaluates the clinical effectiveness of the RelyX™ Unicem Self-Adhesive Universal Resin Cement for cementing all ceramic inlays. Additionally, the influence of selective enamel etching prior to cement application was tested.

Result of the study: The recall rate after 2 years was excellent. According to the authors RelyX Unicem cement showed acceptable clinical behaviour after 2 years in clinical service. Additional selective enamel etching did not yield significantly different results.
Prospective Study of Cementing Metal-Ceramic Crowns with Two Cementing Agents

A. PIWOWARCZYK, K. SCHICK, and H.-C. LAUER, Johann Wolfgang Goethe-University Frankfurt, Frankfurt/Main, Germany

Objectives: To compare the clinical success of a self-adhesive resin cement to that of a zinc-phosphate cement in a prospective split-mouth clinical study.

Methods: Twenty patients (mean age: 53.6 years) received 40 fully veneered posterior metal-ceramic crowns cemented with a self-adhesive resin cement (RelyX Unicem Aplicap, 3M ESPE; n=20) or a zinc-phosphate cement (Hoffmann’s, Hoffmann; n=20). Fifteen parameters related to abutment and periodontal status were evaluated at six examination points (before insertion, at insertion and 0.5, 1, 2, and 3 years after insertion). Abutment sensitivity was additionally evaluated at the same times plus 3–10 days after placing the corer restoration, at the framework try-in, and 3–10 days and 4 weeks after insertion, using a visual analog scale. Statistical data analysis was performed using a single-classification analysis of variance (α=0.05) and a logistic regression.

Results: The mean observation period was 1.79 ± 0.85 years. The dropout rate was zero. RelyX Unicem and zinc-phosphate cement exhibited barely differences with regard to the tested variables. None of the abutments exhibited any secondary caries in the marginal region. No significant differences between the cementing agents could be demonstrated for the visual analog scale (p>0.05) or for hypersensitivity (OR=1.3). By contrast, the mean sulcus-fluid flow rates were higher for zinc-phosphate cement than for RelyX Unicem (9.24 units) (p=0.0006). Minimal to noticeable improvements with regard to the parameters Periotest, sulcus-bleeding index (SBI), proximal plaque index (API), simplified oral hygiene index (OHI-S), and plaque index (PI) variables were evident over the observation period.

Conclusion: At the end of the observation period, the cementing agents examined showed comparable clinical results with fully veneered metal-ceramic crowns. The sulcus-fluid flow rate was lower for RelyX Unicem than for the zinc-phosphate cement.

3M ESPE Summary

Aim of the study: In this clinical study, RelyX™ Unicem Cement Resin was used to adhesively cement PFM crowns and compared to a zinc phosphate cement proven for decades in this indication.

Results of the study: Over an observation period of max 3 years, RelyX Unicem cement performed comparable or better than the control material for cementing PFM crowns, especially sulcus fluid flow rate as a marker for gingiva irritation was lower for RelyX Unicem cement over the whole examination period.
Influence of Cement Type on Fatigue Life of ProCAD Ceramic

R.R. SEGHI, E. ALAKHRAS, N. KATSUBE, and S. ROKHLIN, Ohio State University, Columbus, OH

Objectives: Fractographic analysis of failed ceramic crowns has indicated that the failure initiation site commonly originates at the ceramic-cement interface in the form of a radial crack. The goal of this work is to determine the influence of the cement type on radial crack formation and hence the fatigue life of model ProCAD ceramic restorations.

Methods: Fifty-four ceramic plates approximately 1mm thick were sectioned from CEREC blocks (ProCAD, Ivoclar) with a diamond wheel saw, ground flat with a 600 grit SiC slurry and etched with 5% HF acid for 1 min. The ceramic plates were silanated (Silane Primer, Kerr) and arbitrarily divided into two equal groups. The silanated ceramic plates were luted to flattened human molar teeth with either Cement A (Nexus, Kerr) or Cement B (Unicem, 3M ESPE) following manufacturers instructions. The trilayer specimens were subjected to cyclic vertical indentation loading (300N max) at a rate of 1.6 Hz. The specimens were examined at 0.5, 1, 2, 3, 4 and 5 million cycles under magnification and transillumination. Observation of a radial crack in the ceramic indicated failure and the number of cycles to failure was recorded. The data was analyzed using survival analysis methods (JMP 7, SAS Institute)

Results: The log-rank test between groups indicates that there was a significant difference (p<.001) between the survival curves of the two groups. Cement B resulted in significantly fewer ceramic fractures than cement A after 5 million loading cycles. Further work is needed to determine the mechanism responsible for this dramatic difference.

Conclusions: The cement type can significantly influence the fatigue life of ProCAD ceramics in vitro.

3M ESPE Summary

Aim of the study: This study analysed the influence of the resin luting cement on crack formation in leucite reinforced glass ceramic (ProCAD) restorations.

Results of the study: After cyclic loading of up to 5 million cycles, cementation of ProCAD Ceramic to human tooth with RelyX™ Unicem Resin Cement resulted in significantly fewer cracks in the ceramic than cementation with the conventional resin cement Nexus.
Single and Multi-Step Luting Agents After Four-Years

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The study was as an equivalence protocol to evaluate differences in post-operative sensitivity using a dental cement (RelyX Unicem, 3M ESPE) relative to a dental cement (Variolink II, Ivoclar/Vivadent) used for a long period of time and considered a “gold standard” by many clinicians.

**Objectives:** A 4-year follow-up of subjects who finished a RCT study in 2004 for posterior indirect inlay/onlay ceramic restorations seated with single-step vs. multi-step resin luting agent.

**Methods:** Originally, 54 subjects (95 restorations) completed a 1-year recall. 26 subjects (40 restorations) completed the 4-year follow-up. In the study, subjects had Class I or II ceramic restorations seated and placed on max or mandibular premolars or molars. Restorations were randomized based on the luting system [Single step: Unicem 3M ESPE (n=48 original and 21 at 4 year) or multi-step: Variolink, Ivoclar (n=47 original and 19 at 4 year)]. The outcome assessment [USPHS criteria and Pain and Sensitivity] at 1 year and 4 years were determined by two calibrated examiners. Pain and sensitivity assessment used the 21 point VAS pain instrument.

**Results:** Twelve month agreement for USPHS criteria was 100% except for adaptation (93.8%), discoloration (92.6%), and color match (90.1%). At 4-year follow-up, observer agreement for USPHS criteria was 100% (corresponding to Kappa of 1.0). In addition, there was an increase in Bravo scores for all USPHS criteria regardless of cement. All criteria were Alpha or Bravo, except Color Match which had one restoration rated as Charlie. In both evaluations, there was no difference in post-operative sensitivity.

**Conclusion:** At the 4-year follow-up, there was no evidence of an affect associated with treatment group for any measures, using a 0.05 level of significance. This was the case for the USPHS criteria and the VAS scale. Supported by 3M ESPE.

**3M ESPE Summary**

**Aim of the study:** All-ceramic Class I and II restorations were placed with RelyX™ Unicem Resin Cement and with the conventional total etch cement Variolink II in a split mouth design.

**Results of the study:** At the 4-year follow-up examination, RelyX Unicem cement performed as well as Variolink II.
IPS-Empress Inlays Luted with a Self-Adhesive Resin Cement After Three Years

M. TASCHNER1, R. FRANKENBERGER1, A. PETSCHELT2, and N. KRÄMER3, 1University of Erlangen-Nuremberg, Erlangen Bavaria, Germany, 2University of Erlangen-Nuremberg, Erlangen, Germany, 3University of Dresden, Dresden, Germany

Objectives: Aim of the present prospective controlled clinical study was to compare clinical performance of two different resin composites for luting IPS Empress inlays and onlays.

Materials and Methods: Eighty-three IPS Empress restorations (70 Class-II inlays, 13 onlays/47 premolars, 36 molars) were placed in 30 patients (19 female/11 male, mean age 39.4 years). All restorations were inserted under rubber dam. Forty-three inlays/onlays were luted with a self-adhesive resin cement (RelyX Unicem [RX], 3M ESPE, Seefeld, Germany). A total-etch multi-step adhesive (Syntac) was used with Variolink II low ([SV] Ivoclar-Vivadent, Schaan, Principality of Liechtenstein) and served as control (n=40). The restorations were evaluated after two weeks (baseline=1st recall=R1), after six months (R2), after one year (R3), after two years (R4) and after three years (R5) by two calibrated examiners using modified USPHS criteria.

Results: From R1 to R5, one failure occured in the SV group (R2) due to marginal enamel chipping and three failures in the RX group (R5) because of partial or bulk ceramic fractures. After three years of clinical service, SV revealed significantly better results regarding marginal integrity and integrity inlay (Mann-Whitney U-test, p<0.05). No statistically significant differences were computed between SV and RX for the remaining criteria (Mann-Whitney U-test, p>0.05). The absence of enamel in proximal boxes (10% with no enamel and 51% of the restorations with less than 0.5 mm residual enamel width in the proximal box) did not have any influence on marginal performance of the inlays and onlays (Mann-Whitney U-test, p>0.05).

Conclusion: The self-adhesive resin composite RelyX Unicem showed acceptable clinical behavior after three years of clinical service.

Supported by 3M ESPE, Seefeld, Germany.

3M ESPE Summary

Aim of the study: All-ceramic inlays and onlays were placed with the self-adhesive resin cement RelyX™ Unicem Resin Cement and compared to the conventional total etch cement Variolink II in a split mouth design.

Results of the study: After three years the self-adhesive universal resin cement RelyX Unicem cement showed acceptable clinical behaviour. No significant differences to the total etch system Variolink II was found regarding color match, surface roughness, tooth integrity, sensitivity and patient satisfaction.
Objective: To evaluate the retention of all-ceramic crowns cemented to extracted teeth with resin cements.

Methods: Extracted teeth embedded in acrylic, with the coronal part exposed, were prepared for a full coverage crown with a 20° taper. Crowns were made for the teeth using the CEREC 3D CAD/CAM system (Sirona). The occlusal surface was designed in an elevated mode to allow for a hole that accommodated the pull-off hook. For all crowns the internal surfaces were sandblasted. Dentin bonding agents were used and ceramic conditioners were applied if required by the cement manufacturer. The crowns were cemented with six different cements, ME (MaxcemElite, Kerr SDS), ML (MultiLink Ivoclar-Vivadent), NX (Nexus III Kerr SDS), SC (SmartCem Dentsply Caulk), UC (Unicem, 3M ESPE) and VL (Variolink Ivoclar-Vivadent). After cementation the crowns were incubated at 37°C for 24 hours. Testing was done at a crosshead speed of 2 mm/min.

Results: For three of the cements more than half of the specimens failed by fracture of the crown, while leaving the dentin entirely covered with ceramic. The high number of ceramic failures precluded the use of censored data analysis (Weibull analysis). Thus we report here the mean load for all failures, and a Censor Fraction (CF) the ratio of ceramic failures to the total number of specimens for each cement.

<table>
<thead>
<tr>
<th>CEMENT</th>
<th>N</th>
<th>Load (N)</th>
<th>S.D.</th>
<th>CF(%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>ME</td>
<td>7</td>
<td>145.4</td>
<td>75.4</td>
<td>14</td>
</tr>
<tr>
<td>ML</td>
<td>7</td>
<td>166.8</td>
<td>77.9</td>
<td>57</td>
</tr>
<tr>
<td>NX</td>
<td>7</td>
<td>153.1</td>
<td>81.9</td>
<td>71</td>
</tr>
<tr>
<td>SC</td>
<td>7</td>
<td>66.5</td>
<td>40.0</td>
<td>0</td>
</tr>
<tr>
<td>UC</td>
<td>6</td>
<td>192.6</td>
<td>74.6</td>
<td>17</td>
</tr>
<tr>
<td>VL</td>
<td>7</td>
<td>174.0</td>
<td>52.6</td>
<td>57</td>
</tr>
</tbody>
</table>

The mean load for all ceramic failures for all cements was 194.3 (52.9) N.

Conclusions: The bond strength of the crowns to dentin for these cements (except SC) begins to equal the tensile strength of the ceramic, suggesting that optimum cement strengths are achieved for this ceramic.

3M ESPE Summary

Aim of the study: Six different conventional resin and self-adhesive resin cements were compared regarding the retention of all-ceramic crowns to human teeth.

Results of the study: In a clinically relevant crown pull-off test with abutment design relying on adhesive performance, RelyX™ Unicem Resin Cement showed the highest mean retentive force.
RelyX™ Unicem Cement

Five-Year Evaluation of Zirconia-Based Bridges in General Practice: Year-Three Results

R.J. CRISP, University of Birmingham UK, Cheshire, United Kingdom, and F.J.T. BURKE, University of Birmingham, Birmingham, England, UK

Objectives: The clinical evaluation of the performance of Lava™ zirconium oxide all-ceramic bridges using LavaCeram™ veneering porcelain and cemented with the self-adhesive resin cement RelyX Unicem™ (3M ESPE, Seefeld, Germany) placed in 4 UK general dental practices (two in England, and one each in Scotland & Northern Ireland) over a five-year period.

Methods: Tooth preparation, bridge construction (at one central laboratory) and cementation were all performed to manufacturer’s instructions. The operator, using modified Ryge criteria, assessed at baseline marginal fit, colour match and gingival health. Annual reviews, by a calibrated examiner and the operator, also evaluated secondary caries status, surface quality and post-operative sensitivity.

Results: Forty-two bridges have been placed, and to date 19 bridges (mean age 34.1 months) in 17 patients (13 Female and 4 Male) have been reviewed at three-years (39 bridges reviewed at one-year, 30 at two-years). No failures, secondary caries or staining were observed. No further veneering porcelain chips were detected (one reported at year-one & one at year-two), otherwise surface quality was optimal. No pain or sensitivity was reported. 94% of bridges were optimal for marginal adaptation & no change in colour match from baseline was detected. The gingival health was as tabulated.

<table>
<thead>
<tr>
<th>1=healthy gingivae</th>
<th>2=mild inflammation</th>
<th>3=moderate inflammation</th>
<th>4=severe inflammation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Baseline</td>
<td>One year</td>
<td>Two year</td>
<td>Three year</td>
</tr>
<tr>
<td>Facial</td>
<td>85% 1, 15% 2</td>
<td>95% 1, 5% 2</td>
<td>92% 1, 4% 2, 4% 3</td>
</tr>
<tr>
<td>Mesial</td>
<td>82% 1, 18% 2</td>
<td>100% 1</td>
<td>100% 1</td>
</tr>
<tr>
<td>Distal</td>
<td>85% 1, 15% 2</td>
<td>95% 1, 5% 2</td>
<td>94% 1, 6% 2</td>
</tr>
</tbody>
</table>

Conclusion: After three years of clinical service the all-ceramic zirconia-based bridges continue to give good clinical service and monitoring continues to determine performance over the five-year period.

This study was supported by 3M ESPE AG, Seefeld, Germany.

3M ESPE Summary

Aim of the study: In this clinical study Lava™ Zirconia bridges were adhesively inserted with the self-adhesive universal resin cement RelyX™ Unicem Resin Cement. The clinical performance including gingival health was monitored over three years.

Result of the study: All restorations perform well after three years of clinical service. No sensitivities are reported and healthy gingiva conditions observed.
Objectives: Various resin cements as well as core build-up composites are offered to insert FRC posts. This in vitro study investigated the retentive bond strengths of FRC posts inserted with six core composites and five resin cements.

Methods: Root canals of 120 extracted, anterior teeth were prepared for tapered posts (Erlangen system, Brasseler, size II and 12 mm length). Groups of ten FRC posts were bonded into the post spaces using the following 11 composite materials: Build-It/Cement-It (BI and CI, Jeneric Pentron), Caliba (CA, Dentsply DeTrey), CulmatAT (CU, Bonadent), FlowWhite (FW, Cundente), Luxacore (LC, DMG), MulticoreFlow/Multilink (MF and ML, Ivoclar Vivadent), RebildaDC (R, Voco), PanaviaF (PF, Kuraray) and RelyX Unicem (RX, 3M ESPE). R was combined with two adhesive systems: Solobond (RS, Voco), Adhese (RA, Ivoclar Vivadent). The core composites BI, CU, FW, LC, MF, RS, RA were compared with the resin cements CI, CA, ML, PF, RX. A tensile force test (Instron1026) was performed after moist storage for 24 hr and thermocycling (5–55˚C, 5,000 times). Statistical analysis was carried out (ANOVA-test, Bonferroni-Dunns correction, α<0.05).

Results: Beneficial results were found for resin cements CI (331±85N), CA (408±50N), ML (319±50N) and RX (405±64N) differing not significantly from each other (p>0.05), but CA and RX showed significantly higher bond strengths than PF (243±93N, p<0.05). BI (422±43N) presented significantly higher retentive bond strengths (p<0.05) than all other core composites and were comparable to CA, CI and RX (p>0.05). CU (242±52N), FW (269±31N), MC (296±73N) and RA (331±85N) ranged on the same level, whereas significantly lower values were revealed with LC (145±36N) and RS (148±39N) compared to all other core composites except of CU-RS (p>0.05).

Conclusions: Core composites except of BI did not reach the retentive bond strengths of resin cements. The use of a dual cure adhesive system in the root canal seems to be essential.

3M ESPE Summary

Aim of the study: Resin cements and core build-up materials were compared after artificial aging regarding their adhesive performance when cementing fiber posts into root canals of human teeth.

Results of the study: Of the 11 materials tested, RelyX™ Unicem Resin Cement was among the best materials for cementing fiber post. Only the conventional resin cement Caliba and one core build-up material showed comparable performance.
After initial dimensional calibration of any system used for reproducing 3D objects, the day-to-day performance is determined by the system repeatability. This study set out to determine the repeatability of the 3M ESPE Lava C.O.S. intra-oral scanning system over a single preparation, which determines the system’s capability for capturing the proper location and dimensions of the margin around the preparation.

**Objective:** The purpose of this study was to determine the dimensional repeatability from the Lava C.O.S. 3D intra-oral scanning system over a single prepared tooth from a single scanning system over a two week period of time.

**Methods:** Copper dies of one prepared anterior tooth (#9) and one prepared posterior tooth (#31) were created to simulate real teeth. Each prep was scanned with the Lava C.O.S. system 25 times during a period of two weeks. Geomagic software was used to compare each of the scans, using the original scan as a reference for every comparison, in order to determine the dimensional repeatability from the system. The geometric comparisons evaluate the average positive, average negative, maximum, minimum, and standard deviations for dimensional differences over the entire surface area being compared.

**Results:** Twenty-five repeated scans over the two week period on a single anterior prep and a single posterior prep gave the following results: anterior repeatability ≤5.8 μm with a standard deviation \( \sigma = 1.3 \mu m \), and posterior repeatability ≤10.9 μm with a standard deviation of \( \sigma = 3.5 \mu m \).

**Conclusion:** The Lava C.O.S. 3D intra-oral scanner demonstrated a dimensional repeatability for single preparations that is beyond the requirement to achieve clinical acceptability for marginal adaptation in a crown or bridge restoration (normally accepted to be 50 to 100 μm).

**3M ESPE Summary**

**Aim of the study:** Aim of the study is to determine the dimensional repeatability of the 3M™ ESPE™ Lava™ C.O.S. Intra-Oral Scanning System over a single anterior and a single posterior preparation.

**Results of the study:** The Lava C.O.S. 3D intra-oral scanner demonstrated a dimensional repeatability for single preparations that is beyond the requirement to achieve clinical acceptability for marginal adaptation in a crown or bridge restoration.
Veneering Thickness of Zirconia Frameworks Created with Different Design Methods

M. KRÄMER, and T. MEURER, 3M ESPE AG, Seefeld, Germany

Objectives: CAD/CAM fabricated zirconia based restorations have become a preferred clinical solution. Currently their long term clinical success is discussed to potentially depend on the uniformity of the veneering layer thickness placed manually on the copings. A veneering layer thickness above 2 mm is considered critical. The aim of this study was to compare the thickness of veneering layers on copings designed using different CAD methods.

Methods: Stone models of different (n=6) crown cases were digitized using the Lava Scan ST (3M ESPE) scanner. Copings were digitally designed using three different methods for each case: A standard uniform coping thickness design, a manual design using the virtual waxknife, and a coping automatically reduced from a library-based full contour design. For each model a wax-up of the final restoration shape was available digitally. The veneering layer thickness was computed as the distance between the outer surface of the coping and the final restoration shape. From each comparison the maximum and the average thickness were calculated. The data were analyzed using one-way ANOVA and Tukey’s test (p<0.05).

Results: The following table lists the mean and standard deviation (in brackets) of the maximum and the average veering thickness in mm:

<table>
<thead>
<tr>
<th>Method</th>
<th>Maximum (±SD)</th>
<th>Average (±SD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Automatic</td>
<td>1.45 (±0.06)</td>
<td>0.77 (±0.09)</td>
</tr>
<tr>
<td>Manual</td>
<td>1.68 (±0.26)</td>
<td>0.80 (±0.10)</td>
</tr>
<tr>
<td>Standard</td>
<td>2.33 (±0.52)</td>
<td>1.01 (±0.22)</td>
</tr>
</tbody>
</table>

Both, the average and the maximum veneering thickness of the standard coping designs are significantly larger in comparison to the more advanced design methods, whereas there is no significant difference between the manual and automatic design.

Conclusion: The automatic method of designing anatomically-shaped copings results in veneering layers not significantly different from a manual virtual waxknife design in terms of average and maximum layer thickness. Whether this might be clinically more beneficial than the standard method needs to be proven by further studies.

3M ESPE Summary

Aim of the study: The aim of this study was to compare the thickness of porcelain layers on copings designed using different CAD methods.

Result of the study: Software-generated designs of the veneering structure could achieve comparable porcelain thicknesses done by a well trained dental lab technician and might reduce the risk of failures in oversized porcelain layers.
Objectives: Y-TZP has found wide use for all-ceramic dental restorations due to its high strength and toughness which is attributed to the tetragonal (t) to monoclinic (m) phase transformation (t→m) at crack tips. By using advanced X-ray diffraction (XRD) techniques a quantitative spot measure for t→m at fractured surfaces can be used for differentiating various Zirconia materials and provide new insight into their mechanical behaviour.

Methods: A 1.20 radiation, LynxEye detector)α-X-ray Diffractometer Bruker D8 Discover (Cu-Kα equipped with a 200 µm monocapillary was used to analyze fractured surfaces of 4 commercially available Y-TZP ceramics: LAVA uncoloured (LW), LAVA coloured (LC) (3M ESPE), Everest ZS (BZ) (KaVo) and Zeno Zr (ZZ) (Wieland). The fractured surfaces of bend bars (3 × 5 × 40 mm) broken in static (N=6/material) and during cyclic fatigue (N=6/material) in water were analyzed at three sites: crack origin (O), middle (M) and end (E) of the crack. The quantitative phase analysis (ratio m/t) was performed by the Rietveld method (TOPAS Bruker).

Results: For all samples a significant t→m transformation can be observed (in figure indicated as monoclinic %) and at non-fractured surfaces no monoclinic phase was detected. For each sample t→m decreases from the origin of the crack to the end of the crack. Samples broken during fatiguing generally showed a higher t→m conversion rate than statically fractured samples. Particularly for fatiguing, the materials can be divided in two groups: LV, LB and KV showed significant higher t→m than ZW. Monoclinic % at O: LV=45.6 (42.6–48.6), LB=41.0 (40.2–41.8), KV=45.6 (42.6–48.6), ZW=25.4 (23.1–27.7).

Conclusion: The t→m phase transformation at fractured surfaces is a significant effect directly related to the speed of crack respectively the fracture stress. The spot quantification of t→m allows a precise characterization of the mechanical behaviour of existing Zirconia and provides differentiation among manufacturers.

3M ESPE Summary

Aim of the study: The aim of this study was to compare the t→m transformation behaviour of different zirconia as a function of different manufacturing processes (here: different supplier).

Result of the study: Strength and fracture toughness is attributed to the potential to perform the t→m phase transformation. In this study it was shown that not all 3Y-TZP’s are alike and Lava zirconia shows here the highest potential for t→m transformation.
Objectives: Yttria partially stabilized tetragonal Zirconia is in widespread use as an all-ceramic framework material. Conventional sintering requires a 6–8 hour cycle. Microwave sintering may reduce sintering time to about 1 hour and reportedly improves mechanical properties. The purpose of this study is to measure the flexural strength of this Zirconia materials sintered in a conventional and in a microwave furnace.

Methods: Sectioning of zirconia blocks was accomplished using a Buehler Isomet diamond saw. Blocks of the Vita YZ 40 zirconia were cut into bars and sintered to produce bars approximately 4 mm × 2 mm × 25 mm. Discs of Lava were sectioned and sintered to produce discs approximately 1.2 mm thick × 15 mm in diameter. Specimens were randomly divided into two groups for each zirconia: One sintered in a conventional furnace according to the manufacturer’s recommendations; Vita Zyrcomat and Lava Therm respectively. The other sintered in the Sintermat 1600 microwave furnace. Bars were then tested using a three-point bend test, span 15 mm, with an Instron machine at a crosshead speed of 0.5 mm/min. Lava discs were tested using a biaxial strength test, pin on ring, three balls supporting the specimen with a center load applied using a stainless steel ball. Statistical analysis was conducted using ANOVA and Tukey post hoc test at p=0.05.

Results:

<table>
<thead>
<tr>
<th>Group</th>
<th>Strength (MPa)</th>
<th>Significant Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lava Conventional</td>
<td>960.5 ± 100.8</td>
<td>A</td>
</tr>
<tr>
<td>YZ Conventional</td>
<td>950.2 ± 109.2</td>
<td>A</td>
</tr>
<tr>
<td>Lava Microwave</td>
<td>750.2 ± 120.8</td>
<td>B</td>
</tr>
<tr>
<td>YZ Microwave</td>
<td>762.3 ± 108.3</td>
<td>B</td>
</tr>
</tbody>
</table>

N=12. Groups with the same letter are not significantly different.

Conclusions: There are significant differences between microwave sintering and conventional sintering. Microwave sintering of zirconia using this set of conditions produced significantly lower flexural strength.

3M ESPE Summary

Aim of the study: The aim of this study was to compare the influence of microwave sintering to the strength of dental Zirconia.

Result of the study: Microwave sintering with the reported sintering furnace leads in this study to significant reduced strength. Based on the shown data sintering should only performed following the Zirconia manufacturers guidelines.

Text and graphics above refer to branded products offered by various companies. For trademark information, see the back page of this brochure.

Objective: Compare clinical performance—metal vs. ceramic frameworks; layered vs. pressed veneer ceramic.

Methods: Standardized preparations, RMGI cement, double blinded dentist-patient and dentist-laboratories. Graded in vivo: margins, esthetics, retention, gingival health, endodontic need, caries. Graded in vitro (dies; SEM images): framework and veneer ceramic defects (surface degradation, chips, bodily cracks, breaks, delaminations), wear on prosthesis and opposing dentition. Statistics: ANOVA and Chi Square (p≤0.05).

Results: Ninety-seven percent 3 yr recall. Frameworks: metal—none broken; zirconia—2 broken; alumina—11 broken (p<0.0001). Veneer Ceramics: Over 3 yrs defects progressed in severity and increased in number (compare IADR Abs. #1566, 2008). Pulse interface and CZR Press had fewest defects. 3 yr Success Rates: PFM 94.6%; zirconia 85.1%; alumina 67.6% (p≤0.0005). Defects observed:

<table>
<thead>
<tr>
<th>System</th>
<th>Frame</th>
<th>Veneer Ceramic</th>
<th>Pressed or Layered</th>
<th>n</th>
<th># Could Not Recall</th>
<th>% Defective Prostheses</th>
<th>Defect Details</th>
<th>% Replaced Prostheses</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td># Frame Fractures</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td># Veneer Fractures</td>
<td></td>
</tr>
<tr>
<td>CZR*</td>
<td>Zirconia</td>
<td>CZR Press</td>
<td>pressed</td>
<td>33</td>
<td>2</td>
<td>29%</td>
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<tr>
<td>IPS e.max*</td>
<td>Zirconia</td>
<td>e.max ZirPress</td>
<td>pressed</td>
<td>33</td>
<td>0</td>
<td>48%</td>
<td>0</td>
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<tr>
<td>Cercon</td>
<td>Zirconia</td>
<td>CeramcoPFZ</td>
<td>layered</td>
<td>32</td>
<td>2</td>
<td>63%</td>
<td>1</td>
<td>73</td>
</tr>
<tr>
<td>Everest</td>
<td>Zirconia</td>
<td>InitialZR</td>
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<td>33</td>
<td>1</td>
<td>75%</td>
<td>1</td>
<td>95</td>
</tr>
<tr>
<td>Lava™</td>
<td>Zirconia</td>
<td>LavaCream</td>
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<td>32</td>
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<td>81%</td>
<td>0</td>
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<tr>
<td>Wol-Ceram</td>
<td>Alumina</td>
<td>Cerabien</td>
<td>layered</td>
<td>21</td>
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<td>71%</td>
<td>5</td>
<td>35</td>
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<tr>
<td>Wol-Ceram Experimental</td>
<td>Alumina</td>
<td>Cerabien</td>
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<td>13</td>
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<td>77%</td>
<td>6</td>
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<tr>
<td>Captek</td>
<td>Metal</td>
<td>Creation</td>
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</tr>
<tr>
<td>Ceramco3 (control)</td>
<td>Metal</td>
<td>SoftWear Enamels</td>
<td>layered</td>
<td>32</td>
<td>2</td>
<td>50%</td>
<td>0</td>
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</tr>
<tr>
<td>Pulse interface</td>
<td>Metal</td>
<td>Pulse interface</td>
<td>pressed</td>
<td>32</td>
<td>2</td>
<td>23%</td>
<td>0</td>
<td>12</td>
</tr>
</tbody>
</table>

*Placed 1 year later

Conclusion: At 3 years: PFM systems had statistically best success rate; alumina systems had statistically worst framework performance; zirconia systems had most veneer ceramic defects. Veneer ceramics pressed to metal (Pulse interface) and to zirconia (CZR Press) had least defects.

3M ESPE Summary

Aim of the study: The aim of this study was to compare the clinical performance of zirconia, alumina and metal framework with both pressed or layered veneering.

Results of the study: At 3 year recall 3M™ ESPE™ Lava™ Zirconia Frameworks showed no failures, in contrast to Cercon Zirconia (3% frame fractures), Everest Zirconia (3%) and Wol-Ceram Alumina (24%) frameworks. In this study the major failure mode for Zirconia bridges was veneering ceramic fractures.

Text and graphics above refer to branded products offered by various companies. For trademark information, see the back page of this brochure.
Five-Year Evaluation of Zirconia-Based Bridges in General Practice: Year-Three Results

R.J. CRISP, University of Birmingham UK, Cheshire, United Kingdom, and F.J.T. BURKE, University of Birmingham, Birmingham, England, UK

Objectives: The clinical evaluation of the performance of Lava’ zirconium oxide all-ceramic bridges using Lava Ceram’ veneering porcelain and cemented with the self-adhesive resin cement RelyX Unicem’ (3M ESPE, Seefeld, Germany) placed in four UK general dental practices (two in England, and one each in Scotland & Northern Ireland) over a five-year period.

Methods: Tooth preparation, bridge construction (at one central laboratory) and cementation were all performed to manufacturer’s instructions. The operator, using modified Ryge criteria, assessed at baseline marginal fit, colour match and gingival health. Annual reviews, by a calibrated examiner and the operator, also evaluated secondary caries status, surface quality and post-operative sensitivity.

Results: Forty-two bridges have been placed, and to date 19 bridges (mean age 34.1 months) in 17 patients (13 Female and 4 Male) have been reviewed at three-years (39 bridges reviewed at one-year, 30 at two-years). No failures, secondary caries or staining were observed. No further veneering porcelain chips were detected (one reported at year-one and one at year-two), otherwise surface quality was optimal. No pain or sensitivity was reported. 94% of bridges were optimal for marginal adaptation and no change in colour match from baseline was detected. The gingival health was as tabulated.

<table>
<thead>
<tr>
<th></th>
<th>Baseline</th>
<th>One year</th>
<th>Two year</th>
<th>Three year</th>
</tr>
</thead>
<tbody>
<tr>
<td>Facial</td>
<td>85% 1, 15% 2</td>
<td>95% 1, 5% 2</td>
<td>92% 1, 4% 2, 4% 3</td>
<td>94% 1, 6% 2</td>
</tr>
<tr>
<td>Mesial</td>
<td>82% 1, 18% 2</td>
<td>100% 1</td>
<td>100% 1</td>
<td>100% 1</td>
</tr>
<tr>
<td>Distal</td>
<td>85% 1, 15% 2</td>
<td>95% 1, 5% 2</td>
<td>94% 1, 6% 2</td>
<td>100% 1</td>
</tr>
</tbody>
</table>

Conclusion: After three years of clinical service the all-ceramic zirconia-based bridges continue to give good clinical service and monitoring continues to determine performance over the five-year period.

This study was supported by 3M ESPE AG, Seefeld, Germany.

3M ESPE Summary

Aim of the study: The aim of this study was to assess the clinical performance of 3M™ ESPE™ Lava™ Zirconia Bridges veneered with Lava™ Ceram porcelain and cemented with RelyX™ Unicem Cement.

Results of the study: All-ceramic Lava™ Zirconia bridges placed in 4 UK general dental practices showed good clinical performance. After three years of service from 42 bridges placed (39, 30, 19 examined at year 1, 2, 3) two porcelain chippings were reported. No failures, secondary caries, staining, pain or sensitivity was reported.
Clinical Efficacy of Y-TZP-Based Posterior Fixed Partial Dentures: Five Year Results

A. YU, A.J. RAIGRODSKI, G.J. CHICHE, J.L. HOCHSTEDLER, S.E. MOHAMED, S. BILLIOT, and D.E. MERCANTE,  
‘Louisiana State University School of Dentistry, New Orleans, LA, ’University of Washington, Seattle, WA

Objectives: Assess the clinical efficacy of yttrium tetragonal zirconia polycrystals (Y-TZP)–based posterior three-unit fixed partial dentures (FPDs).

Methods: Subjects missing a second premolar or a first molar, have maintained their opposing dentition, and have signed a consent form approved by LSUHSC IRB, were enrolled in the study using specific inclusion and exclusion criteria. Twenty FPDs (Lava, 3M ESPE) were placed in 16 subjects. Abutments were prepared in a standardized manner: occlusal reduction of 1.5–2.0 mm; axial reduction of 1–1.5 mm with 10˚ taper; finish-line design of 360˚ rounded shoulder located 0.5 mm subgingivally on the facial and supragingivally on the lingual on sound tooth structure; line angles were rounded. Impressions were made with vinyl polysiloxane (Express, 3M ESPE). Y-TZP frameworks were fabricated using CAD/CAM technology with a uniform retainer thickness (0.6 mm) and connector surface area of no less than 9 mm². FPDs with zirconia margins were luted with resin-modified glass ionomer cement (Rely-X luting, 3M ESPE). Recall appointments were made at 2 weeks, 6, 12, 18, and 24 months, and annually thereafter. Fracture measurements, marginal discoloration, marginal adaptation, radiographic proximal recurrent decay, and periapical pathoses were assessed with modified Ryge criteria.

Results: Eighteen FPDs were evaluated at 5 years and one at 48 months (one patient moved away without providing contact information). Fifteen were rated Alpha for fracture measurements and two were rated Bravo (minor veneering porcelain chipping). Two were rated Charlie (major veneering porcelain fracture). Nineteen FPDs were rated Alpha for marginal integrity excluding one rated Bravo. All restorations were rated Alpha for marginal discoloration. One subject experienced root fracture after 60 months, while another was treated surgically for a periapical pathosis on an endodontically treated abutment.

Conclusion: Y-TZP posterior three-unit FPDs performed well after 5-year of service.

This study was supported by 3M ESPE, St. Paul, MN, USA.

3M ESPE Summary

Aim of the study: The aim of this study was to assess the clinical performance of twenty Lava™ Zirconia 3-unit bridges cemented with RelyX™ Luting Cement.

Results of the study: All-ceramic Lava™ Zirconia Bridges performed well after five years of service. 90% of the recalled bridges showed no major chipping of the veneering after 5 years. Marginal integrity was very good.
Efficacy of Zirconia-Based Anterior Maxillary Single Crowns with Customized Copings

A.J. RAIGRODSKI, H. ZHANG, and S. DOGAN, University of Washington, Seattle, WA

Objectives: Assess the clinical efficacy of yttrium tetragonal zirconia polycrystals (Y-TZP)–based anterior maxillary single crowns with customized coping design, in terms of esthetics and survival.

Methods: Subjects who required an anterior maxillary crown, presented with opposing natural dentition, and who have signed a consent form approved by UWHSC Human Subjects Division, were enrolled in the study using specific inclusion and exclusion criteria. Abutments were prepared in a standardized manner: Occlusal reduction of 1.5–2 mm; axial reduction of 1–1.5 mm with minimal 4˚ taper; 360˚ rounded shoulder finish-line located 0.5 mm subgingivally on the facial and supragingivally on the lingual on sound tooth structure; Line angles were rounded. Y-TZP copings were customized with the WaxKnife software (Lava, 3M ESPE) and milled with 0.3 mm thickness at the cervical third and with selective thickness at the mid and incisal thirds to adequately support the veneering porcelain. Twenty crowns (Lava, 3M ESPE) with zirconia margins were luted with composite-resin cement (RelyX Unicem, 3M ESPE) in 18 subjects. Recall appointments were at 2 weeks, 6, 12, and 24 months. Clinical fracture measurements, esthetics, marginal discoloration, marginal adaptation, radiographic proximal recurrent decay, and periapical pathoses, were assessed with modified Ryge criteria.

Results: Twenty restorations were evaluated for up to two years (mean follow-up of 12.7 months, range of service 5–31 months). All restorations were rated as Alpha for fracture measurements. All restorations were rated esthetically successful (16 Romeo, 4 Sierra). Restorations were rated as Alpha or Bravo for marginal integrity. Restorations were rated Alpha for marginal discoloration. No proximal decay or periapical pathoses were detected.

Conclusion: Y-TZP anterior maxillary single crowns with customized anatomic copings with 0.3 mm thickness at the cervical and zirconia margins performed well after short term of service.

This study was supported by 3M ESPE, St. Paul, MN, USA.

3M ESPE Summary

Aim of the study: The aim of this study was to assess the clinical performance of twenty 3M™ ESPE™ Lava™ Zirconia Anterior Crowns cemented with 3M™ ESPE™ RelyX™ Unicem Resin Cement.

Results of the study: All-ceramic 3M™ ESPE™ Lava™ Crowns performed well after up to two years of service. 100% of the recalled crowns were rated Alpha for fracture measurements and marginal discoloration.
Efficient CAD/CAM Veneering Process within the Lava™ System

G. SCHECHNER, B. BURGER, and H. HAUPTMANN, 3M ESPE AG, Seefeld, Germany

Objectives: CAD/CAM based manufacturing has found its established place in laboratories. However, the overall process to obtain a dental restoration still requires several steps involving skilled craftsmen. Particularly, the veneering of frames with conventional techniques is an expensive and non-standardized procedure. An improved CAD CAM supported veneering process should increase the productivity of the lab work flow and the quality of dental restorations.

Methods: Porous milling blocks (VB) of incisal veneering material were produced by compacting and pre-sintering. The VBs were glued into LAVA frames (3M ESPE). A stone model of a crown case was digitized using the LAVA Scan ST Scanner. The full contour shape of the tooth was designed and the virtual veneering layer was generated. LAVA zirconia copings (LC) were produced from the inner data set. An enlarged veneering cap (VC) was milled out of VB using a LAVA Form Mill based the data set representing the veneering layer that was adjusted for the shrinkage of the VB material. VC was filled with slurry of dentin mass, merged on LC and subjected to the firing and finishing. Five restorations produced by this process (LAVA Digital Veneering System, DVS) were cut and analyzed for their quality by microscopy. The aesthetics of DVS crowns were compared with conventionally veneered crowns by a panel of 20 dentists from 1=poor till 10=excellent (three samples respectively from: DVS, layering veneering LAVA Ceram (LC), over-pressing Ivoclar Zirpress (ZP). All samples: one stone model, LAVA zirconia frame, color A2).

Results: Significant bubbles or flaws were detected neither in the veneer nor at the interface between veneering and zirconia. Aesthetic appearance: Lava DVS 7.8 (6.4–9.2), layered veneering 6.9 (5.0–8.8) pressable veneering 6.7 (5.5–7.9).

Conclusion: An effective digital workflow to replace pressable and layering veneering has been defined yielding improved standardization and productivity.
Wear of Enamel Opposed to Dental Resin and Ceramics

A.P. FREITAS, Universidade Federal Da Bahia, Salvador - Ba, Brazil, G. IORGOVAN, University of Western Ontario, London, Canada, M. LAMOS, University of Western Ontario, London, Canada, A.S. RIZKALLA, University of Western Ontario, London Ontario, Canada, G.C. SANTOS-JUNIOR, University Western Ontario, London, On, ON, Canada

Objective: To evaluate the wear of bovine enamel opposed to CEREC crowns made of different materials and surface treatments. The null hypothesis was that there is no influence of material surface treatment on wear of enamel.

Methods: Fifty-five all-ceramic (IPS Empress CAD, Ivoclar/Vivadent; Paradigm C, 3M ESPE; and Vitablocs Mark II, Vident) and resin (MZ100, 3M ESPE) styluses were prepared by milling from a single design with a CEREC 3D system (Sirona). Each set of ceramic stylus (n=5) was subdivided into three surface treatments: unpolished, polished, and glazed. The resin styluses (n=5) were subdivided into unpolished and polished. All styluses were used as wear antagonists. Bovine enamel blocks (8 mm x 9 mm) were mounted onto cylindrical holders designed to fit an Oral wear simulator (Proto-tech, Portland, Oregon). Wear tests were conducted at 30N abrasion and 70N attrition forces applied at 1.7 Hz for 5,000 simulated mastication cycles. Abrasion and attrition wear profiles were evaluated using an Automatic Profilometer (Proto-tech, Portland, Oregon). Statistical analysis of the data were conducted using a Tukey B rank order test, p=0.05.

Results: Enamel abrasion wear ranged from 5μm (MZ100, unpolished) to 104μm (Vitablocs Mark II, glazed). Attrition wear ranged from 5μm (MZ100, unpolished) to 110μm (Paradigm C, unpolished).

Conclusions: There was no effect of antagonist surface treatment on abrasion and attrition wear of bovine enamel, p>0.05. Enamel opposed to resin antagonists exhibited a significantly lower abrasion and attrition wears than their ceramic counterparts, p<0.05.

3M ESPE Summary

Aim of the study: To evaluate wear of bovine enamel opposed to chairside CAD/CAM crowns with different materials and surface treatments.

Results of the study: Antagonist surface treatment had no effect on abrasion and attrition wear of bovine enamel. Paradigm™ MZ100 composite exhibited a significantly lower abrasion and attrition on enamel than the ceramics tested.
Evaluation of Varied Repair Methods Applied to CAD/CAM Blocks

K.R. COULTER, J.E. SCOTT, and T. BONSTEIN, University of Manitoba, Winnipeg, MB, Canada

Objectives: The study aim was to determine the best repair method for five types of CAD/CAM blocks.

Methods: Five CAD/CAM blocks, four ceramic (Vitablocs Esthetic Line—Vident, ProCAD—Ivoclar Vivadent, IPS e.max CAD—Ivoclar Vivadent, Paradigm C—3M ESPE) and one composite (Paradigm MZ100—3M ESPE) were studied. Each block type was sectioned (5 × 2 × 10 mm) embedded and randomly divided into four groups with two types of surface treatments: roughened by a fine diamond bur (Brasseler, USA) or air abraded by 30 μm aluminum oxide particles (CoJet System—3M ESPE). Clearfil Repair (Kuraray America) was applied and polymerized according to manufacturers’ instructions. A cylindrical mould (2.3798 mm by 4 mm) was used to fabricate composite cylinders from two types of composites: flowable (Esthet X Flow—Dentsply) or hybrid composite (Filtek Z250—3M ESPE) resin. Specimens were stored in water at 37˚C for 24 hours and sheared using the Ultradent method with Zwick Z010 Compression Tester set to move at 1 mm/minute. Scanning Electron Microscope (SEM) was used to assess the modes of fracture. ANOVA and Tukey tests analyzed the data (α=0.05).

Results: MZ100 yielded statistically higher shear bond strengths than the other blocks. The best repair method, regardless of block type, was the CoJet/flowable resin combination. When a bur was used there was no statistical difference between the hybrid and flowable resin regardless of block type. No statistically significant difference was found between bur and CoJet when other variables were controlled. Failed specimens showed mostly cohesive fractures within the blocks.

Conclusion: The difference found in the reparability of CAD/CAM blocks may be attributed to block composition. Regardless of block composition the best repairs were obtained with the CoJet/flowable resin combination. With the exception of IPS e.max CAD, all block/surface preparation/resin combinations yielded clinically acceptable shear bond strengths when bonded by Clearfil Repair.

3M ESPE Summary

Aim of the study: The aim of this study was to determine the best repair method for five types of CAD/CAM blocks including the composite block Paradigm™ MZ100 block and the glass ceramic block Paradigm™ C Block.

Results of the study: According to the shear bond strength data presented the best repair method for all type of blocks was to use CoJet silicate ceramic surface treatment system in combination with a flowable composite. The composite block, Paradigm MZ100 block, showed the highest bond strength to the repair composite.
Fatigue Damage and Micro-Leakage Study of Resin-Based Composite Crowns

N. DAVYDOVA, New York University, New York, NY, V. THOMPSON, PEARL Network, New York University, College of Dentistry, New York, NY, Y. ZHANG, New York University, New York, NY

Objectives: The most common causes for failure of dental restorations and recurrence of decay are fatigue-induced damage and marginal micro-leakage of oral fluids. Resin-based composite (RBC) has favorable aesthetic and mechanical properties for use in crowns. A major concern of RBC is its long-term stability. This study investigates contact damage and micro-leakage of the RBC crowns under mouth-motion fatigue with a contact-slide-liftoff action in wet environments.

Methods: Sixteen RBC crowns (Paradigm MZ100 Composite, 3M ESPE) were CAD/CAM-machined using a standard profile scanned from a tooth prepared for crown cementation (first maxillary molar, tooth number 3). Adjustments were made to accommodate a 50 µm thick cement layer. RBC crowns were cemented (RelyX™ Unicem Aplicap, 3M ESPE) to water-aged (60 days) resin-based composite bases (Tetric EvoCeram, Ivoclar Vivadent) fabricated from impressions of the prepared tooth. A mouth-motion simulator was used to apply a cyclic load of 200N for 200k and 1M cycles (WC spherical indenter, r=3.18 mm) to the mesio-buccal cusp ridge of the crown.

Results: Optical microscopy of the occlusal surface revealed wear facets, localized deformation, and incomplete ring cracks at the contact area. Specimens were sectioned along the contact site and dye infiltrated for sub-surface damage evaluation. 200k loading cycles specimens exhibited minimal material loss due to wear and partial cone cracks penetrating ~25% of crown thickness. Specimens that underwent 1M loading cycles showed greater material loss and partial cone cracks penetrating ~30% of crown thickness. Neither specimens displayed marginal micro-leakage. Traces of interfacial de-lamination not extending to the margins were observed, predominantly at the intaglio surface beneath occlusion.

Conclusions: CAD/CAM RBC crowns withstand long-term, high force occlusion in wet conditions. Occlusal contact damage did not reach the crown-tooth interface. Minimal internal adhesive de-lamination was noted, however no marginal micro-leakage was present. Supported by NYUCD Dean’s Award, NIH/NIDCR-5R01DE17925-2, and NSF/CMMI-0758530.

3M ESPE Summary

Aim of the study: Characterize contact damage and microleakage of Paradigm™ MZ100 composite crowns under mouth-motion fatigue with a contact-slide-liftoff action in wet environments.

Results of the study: Paradigm MZ100 composite crowns withstand long-term, high force occlusion under wet conditions. Occlusal contact damage did not reach the crown-tooth interface. Although minimal internal adhesive delamination was noted, there was no marginal microleakage.
Evaluation of Surface Treatment of CAD/CAM Composite


Protocols for the surface treatment of composite materials utilized in indirect posterior restorations are not consistent. The best treatment for the inlay surface remains to be determined.

Objective: This study was designed to determine the best method for preparing the composite indirect material for luting.

Methods: Sixty Paradigm™ (3M ESPE, St Paul MN) MZ100 CEREC® composite discs were prepared at 10 mm diameter 2 mm thick. Specimen were embedded in an acrylic resin and resurfaced with 600 grit paper under irrigation. Specimens were randomly assigned to one of six treatment groups: No treatment (NT), Silane (S), Aluminum oxide etching (AO), Aluminum oxide etching plus silane (AOS), Hydrofluoric acid etching (HF), and Hydrofluoric acid etching plus silane (HFS). Following surface treatment, each specimen was bonded with RelyX™ (ESPE) cement in a 2.38 mm diameter column and light cured. Bond strengths were determined by subjecting each specimen to a shear force at a crosshead speed of 0.5 mm utilizing an Instron 5,566 (Canton, MA). Force at failure was recorded. Mean bond strengths (MPa+sd) were calculated and analyzed with an ANOVA statistic with a Scheffe post-hoc test.

Results: The mean shear forces were HF: 99.5 (±33.4), HFS: 71.8 (±13.3), AO: 112.5 (±11.7), AOS: 118.9 (±15.5), NT: 74.8 (±20.0), S: 107.7 (±11.8). Significant differences were found across treatment groups with the exception of the HF treatment group. S, AO, or AOS treatments displayed higher shear forces as compared to the NT and HFS treatment groups (p<0.05).

Conclusions: HF etch alone was very variable and should not be utilized. Acid etch plus silane treatment and roughened control groups (600 grit) were weaker than all treatments. Accordingly, such treatments should not be used to prepare milled composite surfaces. Silane, air abrasion, or air abrasion plus silane treatments are preferred techniques with low standard deviations and high bond strengths.

3M ESPE Summary

Aim of the study: Determine the best method for preparing the composite indirect material for luting.

Results of the study: Silane, air abrasion, or air abrasion plus silane treatments are preferred techniques with low standard deviations and high bond strengths. Techniques with hydrofluoric acid etching yielded lower bond strengths.
Objective: Blanks made of resin composite are currently available to be used for milling CEREC chairside restorations. There is no sufficient information in the literature about performance of crowns made of such blanks as compared to ones made with ceramic blanks in terms of strength and durability. The objective of this study was to compare fracture strength of ceramic (Empress-CAD) and resin composite (Paradigm MZ) crowns made with CEREC-3D machine.

Methods: An Ivorine molar tooth was prepared to receive an all-ceramic crown and was duplicated using epoxy resin to produce 20 identical prepared specimens. Ten Leucite-reinforced all-ceramic crowns (Empress-CAD, Ivoclar-Vivadent) and ten composite resin crowns (Paradigm MZ, 3M ESPE) were made using CEREC-3D machine. All crowns were cemented to their respective dies using dual-cured resin cement Panavia F 2.0 (Kuraray). Light-curing was applied from buccal, occlusal and lingual surface for 40s each. Specimens were then stored in water at 37°C for one week. Each tooth was then subjected to uniaxial compressive loading to fracture at a crosshead speed of 1 mm/min. Mean fracture stress and standard deviation values were calculated and data statistically-analyzed using one way ANOVA at p=0.05.

Results: No significant difference in mean fracture load was found between the two materials (p=0.390). Mean fracture loads (standard deviation) in N were: 972.28 (256.33) for EmpressCAD crowns and 1078.64 (283.36) for Paradigm MZ crowns.

Conclusions: The performance of the resin composite crowns (Paradigm MZ) was comparable to that of the ceramic (Empress-CAD) crowns when subjected to direct compressive load to failure. Further testing is needed to compare compressive load-fatigue resistance of both types of molar crowns.

Acknowledgements: 3M ESPE, Ivoclar-Vivadent, Kuraray.

3M ESPE Summary

Aim of the study: To compare fracture strength of ceramic and composite crowns made via chairside CAD/CAM.

Results of the study: The performance of Paradigm™ MZ100 composite crowns was comparable to that of the Empress-CAD ceramic crowns when subjected to direct compressive load to failure.
Indirect Restorative References

0165  Direct Evidence for Phase Transformation at Fractured Zirconia Surfaces
G. SCHECHNER, A. SCHMALZL, M. JAHNS, H. HAUPTMANN, and S. SCHERRER, 3M ESPE AG, Seefeld, Germany, Universite de Geneve, Geneva, Switzerland

3222  Veneering Thickness of Zirconia Frameworks Created with Different Design Methods
M. KRÄMER, and T. MEURER, 3M ESPE AG, Seefeld, Germany

3223  Efficient CAD/CAM Veneering Process within the Lava System
G. SCHECHNER, B. BURGER, and H. HAUPTMANN, 3M ESPE AG, Seefeld, Germany

0164  Effect of CoJet™ Sandblasting on Fatigue Data for Y-TZP Ceramics
S.S. SCHERRER, E. VITTECOD, F. DE MESTRAL, M. CATANI-LORENTE, A. WISKOTT, and J.A. GRIGGS, Univ. of Geneva, School of Dental Medicine, Geneva, Switzerland, ‘Univ. of Applied Sciences of Western Switzerland (HES-SO), Geneva, Switzerland, ‘University of Mississippi Medical Center, Jackson, MS

2971  Flexural Strength of Y-TZP Zirconia Sintered Using Conventional and Microwave Sintering
R. GIORDANO, R. L’HERAULT, and M. JACKSON, Boston University, Boston, MA, ‘Precision Ceramics Dental Lab, Montclair, CA

0374  Efficacy of Zirconia-Based Anterior Maxillary Single Crowns with Customized Copings
A.J. RAIGRODSKI, H. ZHANG, and S. DOGAN, University of Washington, Seattle, WA

1636  3-Year Clinical Performance—293 PFM, Zirconia, and Alumina Posterior Prostheses
R.P. CHRISTENSEN, and B.J. PLOEGER, TRAC Research Laboratory, Provo, UT

1637  Clinical Efficacy of Z-Y-TZP Posterior Fixed Partial Dentures-Five Year Results

3234  Five-Year Evaluation of Zirconia-Based Bridges in General Practice: Year-Three Results
R.J. CRISP, University of Birmingham UK, Cheshire, United Kingdom, and F.J.T. BURKE, University of Birmingham, Birmingham, England, UK

2951  Dimensional Repeatability from the Lava C.O.S. 3D Intra-Oral Scanning System

0052  Cementation Effect on the Fracture Load of Two CAD/CAM Materials
T.J. HILL, G.W. TYSOWSKY, and D. COSTANTINO, Ivoclar Vivadent, Amherst, NY

0515  Bond Durability of Maxcem Elite to Lava Substrate
C.J.E. FLOYD, T.D. NGUYEN, X. QIAN, and D. TOBIA, Kerr Corporation, Orange, CA

0519  Effect of Functional Monomers on Tensile Bond Strength to Zirconia
M. TAKI, and S. YAMAGUCHI, KURARAY MEDICAL INC, Kurashiki, Japan

0532  Strength of Zirconia After Mechanical, Thermal and Hydrothermal Loading
L. BORCHERS, T. KELLNER, C. HÜBCHT, M. JENDRAS, F.-W. BACH, P. KOHORST, and M. STIESCH-SCHOLZ, ‘Hannover Medical School Dept. of Prosthodontics, Hannover, Germany, ‘Leibniz University Inst. of Materials Science, Hannover, Germany

0537  Marginal Gap and Fracture Strengths of Ceramic Crowns
J.M. KIM, and J.-M. BAE, Wonkwang University, Dental College, Iksan, South Korea

1522  Simulation and Reliability of All-Ceramic Crowns at Different Anatomic Sites

1766  Fractographic Analyses of Dental High-Strength Ceramics
M. ØILO, H.M. TVINNEREIM, and N.R. GJERDET, University of Bergen, Bergen, Norway

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T. Hooshmand, Dental Research Center, Research Center for Science and Technology in Medicine, Medical Sciences/Tehran University, Iran, M. Mohajerfard, School of Dentalistry, Medical Sciences/Tehran University, Iran, and A. Keshvad, School of Clinical Dentistry, Shahed University, Tehran, Iran

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T. Hooshmand, Dental Research Center, Research Center for Science and Technology in Medicine, Medical Sciences/Tehran University, Iran, M. Mohajerfard, School of Dentalistry, Medical Sciences/Tehran University, Iran, and A. Keshvad, School of Clinical Dentistry, Shahed University, Tehran, Iran

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R.M. Lindblad, L.V.J. Lassila, P.K. Vallittu, and T. Jaderhane, ‘City of Helsinki Health Centre, Finland, ‘University of Turku, Finland, ‘University of Helsinki, Finland
Adper™ Scotchbond™
SE Self-Etch Adhesive

Twelve Month Clinical Performance of a Self-Etch Adhesive
E. YAZICI, A. KIREMITCI, and S. GURGAN, Hacettepe University, School of Dentistry, Ankara, Turkey

Objectives: This practice-based, randomized, controlled pilot study evaluated the 12 month clinical performance of a self-etch adhesive in combination with a nanocomposite for the restoration of Class V non-carious cervical lesions.

Methods: Eighteen patients with at least two but not more than six equivalent non-carious cervical lesions participated in this study. A total of 80 non-carious cervical lesions were randomly assigned into two groups according to adhesive systems used (n=40). In Group 1 (control), the lesions were treated with an etch-rinse adhesive (Single Bond 2/3M ESPE). In Group 2, the lesions were treated with a two-step self-etch adhesive (Adper SE Plus/3M ESPE). A nanocomposite (Filtex Supreme XT/3M ESPE) was used as the restorative material according to the manufacturer’s instructions by one operator. The restorations were evaluated for retention, color match, marginal adaptation, wear, anatomic form, marginal discoloration, recurrent caries, post-operative sensitivity and surface texture at baseline, 1 week, 6 months and 12 months according to the modified USPHS criteria by two other independent examiners. The differences between the groups were evaluated using McNemar Chi-Square test (p=0.05).

Results: Eighty restorations were reviewed in 18 patients at 12 month recall. Retention rate, anatomic form, recurrent caries, wear, surface texture, post-operative sensitivity were scored as Alpha (100%) for all restorations in the two groups. For color match, 87.5% of the restorations in Group 2 and 100% of the restorations in Group 1 were scored as Alpha but the difference between the groups was not significant (p>0.05). Group 1 exhibited significantly better clinical performance in terms of marginal adaptation at 12 month recall (p<0.05).

Conclusions: At the end of 12 months, the clinical performance of the tested self-etch adhesive was comparable with the etch–rinse adhesive used.

3M ESPE Summary

Aim of the study: Evaluate the performance of a self-etch adhesive system (3M™ ESPE™ Adper™ Scotchbond™ SE Self-Etch Adhesive) in Class V restorations in comparison to a total-etch adhesive (3M™ ESPE™ Adper™ Single Bond 2).

Results of the study: The overall performance of the self-etch adhesive was reported to be comparable to the total etch control after 12 months.
Clinical Performance of Cervical Restoration with Potassium Oxalate-Based Desensitizing

N. SARTORI, G. LOPES, and L.C.C. VIEIRA, Universidade Federal De Santa Catarina, Florianópolis, Brazil

Objective: Evaluate the clinical performance and post-operative sensitivity of non-curious cervical restoration with and without the use of a potassium oxalate-based desensitizing agent after 18 months.

Methods: Upon IRB approval and informed consent 144 non-curious cervical lesions were selected and randomly divided in four groups: in Group I (GI) the teeth were restored using a potassium oxalate-based desensitizing agent (BisBlock, Bisco) after acid etching and before the application of Adper Single Bond 2 (3M ESPE). In Group II (GII) the teeth were restored using the same adhesive system used in GI, without the use of desensitizing agent. Group III (GIII) was restored in the same way of GI, but using One-Step (Bisco) as the adhesive system. Group IV (GIV) was restored with the same adhesive of GIII, but without the application of BisBlock. Filtek Supreme (3M ESPE) was used to restore GI and GII, and Aelite (Bisco) was used to restore GIII and GIV. All 144 restorations were evaluated after 1 week, 2, 6, 12 and 18 months according to the modified USPHS criteria. McNemar test was used to identify anterations in the alfa index within groups throughout the evaluated periods. Qui-square test was used to detect interactions among groups in each period.

Results: No statistical differences between groups restored with or without the use of a desensitizing agent regarding induced and reported sensitivity. After 18 months, retention rates showed to be statistically lower for One-Step than Adper Single Bond 2.

Conclusions: The use of potassium oxalate-based desensitizing agent did not decrease post-operative sensitivity neither improved the clinical performance.

3M ESPE Summary

Aim of the study: Evaluate the 18 month clinical performance and post-operative sensitivity of non-curious Class V restorations (3M™ ESPE™ Filtek™ Supreme Universal Restorative) bonded using 3M™ ESPE™ Adper™ Single Bond 2 plus Adhesive or Bisco One Step™ Adhesive with and without prior treatment of an adjunctive potassium oxalate desensitizing agent.

Results of the study: After 18 months, Adper Single Bond 2 adhesive showed higher retention rates than Bisco One-Step. Use of an adjunctive desensitizing agent did not decrease post-operative sensitivity.
Microtensile Bond Strength *In Vivo*: Effect of Cavity Depth

G.C. LOPES, A. CORRÊA, and G.M. OLIVEIRA, Universidade Federal De Santa Catarina, Florianópolis-SC, Brazil

**Objectives:** To compare microtensile bond strength (MTBS) of an adhesive system applied on shallow and deep Class I *in vivo*.

**Methods:** After approval from six patients from 18 to 21 years-old, a Class I cavity was prepared in caries-free pre-molars scheduled to be extracted for orthodontic reasons. The six patient selected had two pared pre-molars. The Class I cavity in one side exposed shallow dentin. The dimensions of the cavities were: 1.5 mm depth, 2.5 mm width and 2.5 mm large. And, in other pre-molar the Class I cavity was different only in depth (4 mm). The vitality of the experimental teeth was confirmed by thermal vitality test and bite-wing radiographies were done to control the cavities dimension. Local anesthesia without epinephrine was administered and the cavities were done with cylindrical diamond burs under water coolant. The field was isolated with rubber-dam. The cavities were acid-etched with 35% phosphoric acid and Single Bond 2 (3M ESPE) was applied followed by Filtek Supreme XT (3M ESPE) with an oblique increment technique. The patient was examined after 24 hr, 7 days and 30 days. After 30 days, teeth were carefully extracted and cut in two perpendicular directions to obtain sticks with low-speed saw with a cross section of 0.5 mm$^2$ (n=20). The MTBS was measured in an Instron (0.5 mm/min). After test, all beams were analyzed at SEM.

**Results:** Non post-operative sensitivity was related. Mean (±SD) MTBS were: shallow cavity=44.6 (±18.5), deep cavity=34.6 (±18.4). The t-test showed no difference (p<0.058). SEM analyses showed major mixed failure for both groups, failures at the base of hybrid layer was more present in deep cavities.

**Conclusion:** Bonding strength to deep dentin *in vivo* was similar than to shallow dentin.

Supported by CNPq.

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3M ESPE Summary

**Aim of the study:** Evaluate microtensile bond strength of a total-etch adhesive (3M™ ESPE™ Adper™ Single Bond 2) to shallow and deep dentin in Class I restorations prepared *in vivo*.

**Results of the study:** There was no difference in the dentin bond strengths prepared in shallow and deep preparations *in vivo*.
Clinical Evaluation of Self-Etching Adhesive System in Primary Dentition

A.M. BIONDI, Universidad de Buenos Aires, Buenos Aires, Argentina, and S.G. CORTESE, University of Buenos Aires, Buenos Aires, Argentina

Self-etching adhesive systems showed easier handling and less operative time to be used in pediatric patients than conventional etching single bottle systems.

Objectives: Evaluate need for replacement of restorations involving one or more tooth surfaces placed in primary dentition using a self-etching adhesive system 3M ESPE Adper Prompt (SE) compared with a single bottle system with previous enamel conditioning (3M Adper Single Bond 2) (C).

Methods: n=119 restorations were placed by two calibrated operators in small and moderate carious lesions in vital deciduous teeth of patients between 2 and 9 years old. (5.25±1.83). Patients were randomly assigned to one of two groups: SE n=72 (SE1: n=59 single-surface and SE2=13 two or multiple-surface) and C n=47 (C1: n=32 single-surface and C2: n=15 two or multiple-surface). Complete elimination of carious tissues, relative isolation, rinse and dry of preparations were carried out in all the samples. In C, the samples were etched (37% H3PO4) (enamel-30, dentine-7”), washed (15”), and dried. 2–3 consecutive coats of adhesive (15”) were applied, gently air dried (5”) and light-cured (10”). In SE, adhesive-system (15”) was applied using a rubbing motion, air dried, then a second layer was applied (no rubbing or waiting time) and light-cured (10”). 3M Z100 was used as the only restorative material in both cases. Restorations were immediately finished and polished with multifluted carbide finishing burs. Evaluations were assessed at baseline and at recalls using the USPHS system modified. Data were analyzed using Tukey Kramer and Fisher Exact test.

Results: 100% of restorations were evaluated at 341±147 days. There were no significant intergroup differences concerning the time period for assessments (P>0.05), and concerning need for replacement for restorations between C1-SE1 (P=0.3320); C2-SE2 (P=1); C1-C2 (P=0.4036) y SE1-SE2 (P=1).

Conclusions: Restorations showed similar need for replacement independently from the adhesive system used and the number of surfaces affected.

3M ESPE Summary

Aim of the study: To compare the replacement rate between composite restorations bonded with a self-etch adhesive (Adper Prompt Self-Etch Adhesive) and a total etch adhesive Adper Single Bond Plus Adhesive) in primary teeth.

Results of the study: Over a recall of approximately 6 to 18 months, there was no difference in the replacement rates of restorations bonded with the two adhesive systems.
Ketac™ Nano Light-Curing Glass Ionomer Restorative

Mechanism of Curing and Interfacial Bonding of RMGI with Hydroxyapatite

J.D. Oxman¹, S.B. Mitra¹, T. Ton¹, H.T. Bui¹, A. Falsafi¹, R. Halvorson², C.-Y. Lee¹, and Y. Wang¹, ¹3M ESPE Dental Products, Saint Paul, MN, ²3M ESPE Dental Products, St. Paul, MN

Objectives: Study the curing mechanism of Ketac Nano RMGI and determine the interfacial bonding interactions of its primer with hydroxyapatite (HAP).

Methods: Curing reactions of Ketac™ Nano (KN) Light Curing Glass Ionomer Restorative and Vitremer™ (VM) RMGI were studied by FTIR. KN pastes and VM powder-liquid were mixed per IFU, applied to KBr discs and light-cured. Spectra recorded at 2, 4, 6 minutes, then every 5 to 60 mins and every 1 hr to 24 hr. Interfacial interaction was determined by FTIR using HAP, KN primer (KNP) and KNP-treated HAP followed by digital subtraction. XPS study (Kratos AXIS Ultra DLD) performed on: HAP discs (N=3, 2 spots each) sonicated in ultrapure 18 mW water (U18W) and nitrogen-dried, same disks treated with KNP, rinsed in U18W and dried, polyalkenoic acid of KNP (VBP) and a control Ca-polyalkenoate prepared from VBP. Statistical analysis was via ANOVA and Tukey’s t-test (p<0.05). High resolution C1s spectra were acquired at 20eV pass energy and charge-referenced to Cls hydrocarbon peak set to 285.0eV.

Results: FTIR of curing-reaction showed decrease in methacrylate (1295, 1325 cm⁻¹) and progressive increase in carboxylate (1570 cm⁻¹) peaks. Subtraction of KNP-treated HAP minus KNP showed intense carboxylate peak due to ionic-bonding. Elemental compositions via XPS are in the table as atomic % (SD). Superscripts denote groups not statistically different. Elevated C and N levels on treated HAP show adhesion of KNP to HAP. The O-C=O (289eV) peak broadened and shifted to lower binding energy for treated HAP showing evidence of chemical bond. This shift was consistent with the peak position for the synthesized calcium-polyalkenoate.

<table>
<thead>
<tr>
<th>Sample</th>
<th>Ca</th>
<th>P</th>
<th>N</th>
<th>C</th>
</tr>
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<tr>
<td>HAP</td>
<td>19 (1.1)</td>
<td>13 (0.8)</td>
<td>0</td>
<td>15 (5.9)</td>
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<tr>
<td>HAP-KNP</td>
<td>15 (0.4)</td>
<td>11 (0.2)</td>
<td>2.4 (0.3)</td>
<td>25 (0.2)</td>
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<tr>
<td>VBP</td>
<td>0</td>
<td>0</td>
<td>2.6 (0.4)⁺</td>
<td>70 (0.9)⁺</td>
</tr>
<tr>
<td>VBP-Ca</td>
<td>4.9 (0.5)</td>
<td>0</td>
<td>1.3 (0.3)⁺</td>
<td>68 (1.5)⁺</td>
</tr>
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</table>

Conclusions: FTIR showed methacrylate and acid-base GI reactions in KN and VBP. XPS and FTIR showed that the polyalkenoic acid in the primer (KNP) chemically bonds to HAP.

3M ESPE Summary

Aim of the study: Investigate the curing mechanism and interfacial bonding interactions of a nanoionomer restorative material (3M™ ESPE Ketac™ Nano Light-Curing Glass Ionomer Restorative) using FTIR and X-ray photoelectron spectroscopy (XPS).

Results of the study: FTIR reveals both methacrylate and glass-ionomer reaction mechanisms during the curing phase of Ketac Nano restorative. XPS and FTIR validate the reaction between the polyalkenoic acid in Ketac Nano primer and hydroxyapatite.
Objectives: Evaluate the clinical performance of the Atraumatic Restorative Treatment restorations-ARTs realized with two different glass-ionomer restorative materials: Ketac Molar Easy Mix® (3M ESPE) e Vitro Molar® (DFL) in babies affected by the Early Childhood Caries after a 12 months period.

Methods: It was a randomized-clinical trial, double-blind, split-mouth. The sample was composed by 20 children with ages from 18 to 36 months old, in a total of 99 ARTs with two glass-ionomer restorative materials from different brands. The clinical evaluation was done by a trained and calibrated examiner, using the modified USPHS criteria. For comparison of the evaluated parameters between the materials, the Test Qui-Square (p<0.05) was used.

Results: The success found was of 98% for Vitro Molar® (DFL) and 100% for Ketac Molar Easy Mix® (3M ESPE), no statistics difference was found between both materials (p>0.05).

Conclusions: We have concluded that ARTs with both glass-ionomer restorative materials has shown excellent clinical performance, after a 12 months period during treatment for Early Childhood Caries.

3M ESPE Summary

Aim of the study: This clinical study evaluated the performance of glass ionomers used with Atraumatic Restorative Treatment technique in small children.

Results of the study: After one year, Ketac™ Molar Easymix showed excellent clinical performance in this indication with 100% clinical success.
24-Month Evaluation of Glass-Ionomer Sealants in a Clinical Randomized Trial

A.R.F. CASTILHO, State University of Campinas, Bauru, Brazil, P.A. SACRAMENTO, State university of Campinas, Piracicaba, Brazil, A.F.S. BORGES, State University of Campinas, Piracicaba, Brazil, and R.M. PUPPIN-RONTANI, State University of Campinas, Piracicaba - SP, Brazil

Objective: The aim of this study was to compare the clinical performance of Ketac Molar (K) and Fuji IX (F) glass ionomer cements as sealant in a clinical randomized trial.

Methods: A prospective study (CRT) was carried out with a sample of 79 schoolchildren aged from 6 to 9 year-old. Each subject was randomized to receive one sealant material on one side and the other sealant material on the contra lateral side. All pits and fissures were cleaned with a probe and wet cotton pellets in order to remove dental biofilm and debris. The same dentist (PAS) using the “press-finger” technique placed all sealants using relative isolation. The total of 98 permanent first molars was sealed with Fuji IX and 99 with Ketac Molar in a split mouth design randomly assigned in the same child. The follow-up was made at baseline, 3, 6, 12 and 24 month. For the sealants successful, caries lesion absence was considered. Wilcoxon, Mann-Whitney and Log-Rank Tests (p<0.05) were used for statistical analysis.

Results: For the Ketac Molar sealants, there was no significant difference on success rate until the 12 months. For Fuji IX sealants, at 3 months evaluation the success rate decreased significantly, having a new significant reduction only at 24 months. No significant difference was found between both the materials, in the same period of time.

Conclusion: This study supports the evidence that both materials showed high and similar success rates after 24 months. Additionally, Ketac Molar and Fuji IX glass ionomer cements can be used for occlusal sealing treatment using “press-finger” technique.

3M ESPE Summary

Aim of the study: In this clinical study two glass ionomers were evaluated as sealants in 6–9 year old school children with the “press finger” technique.

Results of the study: In clinical use, Ketac™ Molar and Fuji IX were successful after 24 months as occlusal sealants.
Post-Cure Adhesion of RMGI Liner Materials

S.B. MITRA, H.T. BUI, K.M. CUMMINGS, J.C. ROLF, R.P. RUSIN

Objectives: Evaluate the dentin and enamel adhesion of a new resin modified glass ionomer (RMGI) liner during the first 24 hr after application. The liners tested were 3M™ ESPE™ Vitrebond™ Plus Light Cure Glass Ionomer Liner/Base (VBP), 3M™ ESPE™ Vitrebond™ Light Cure Glass Ionomer Liner/Base (VB), and Fuji™ Lining LC Paste Pak (FPP). VBP is a new resin-modified glass ionomer material in a paste/paste delivery, which exhibits the aluminum-carboxylate crosslinking reaction and fluoride release of a true glass ionomer.

Methods: Shear bond strength was measured on bovine dentin and enamel using the wire loop method (crosshead speed 1 mm/min) on an Instron 1,123. A 0.3 mm tape spacer ensured a reproducible, uniform layer of the liner on the dentin. After etching the cured liner with 3M™ Scotchbond™ etching gel, 3M™ Single Bond™ Plus adhesive was applied and cured. A cylinder of 3M™ ESPE™ Filtek™ Z250 Universal Restorative was cured onto the sample. The samples were immersed in 37°C deionized water before testing; storage times were 0.25, 1, 4, 24 hr (n=5 for each group). The data were analyzed via one-way ANOVA and compared with Tukey’s T-test (p=0.05).

Results: Bond strengths are shown below. Groups with the same letter superscript are not statistically different. For each material, dentin bond strengths were not statistically different at all times; the same was true for enamel bond strength. Dentin Adhesion, MPa(StDev)

<table>
<thead>
<tr>
<th>time (hr)</th>
<th>VBP</th>
<th>VB</th>
<th>FPP</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.25</td>
<td>3.67 (0.98)*</td>
<td>5.40 (1.06)*</td>
<td>3.88 (2.56)*</td>
</tr>
<tr>
<td>1</td>
<td>5.00 (2.11)*</td>
<td>3.98 (0.76)*</td>
<td>4.79 (0.77)*</td>
</tr>
<tr>
<td>4</td>
<td>5.91 (0.93)*</td>
<td>6.63 (1.53)*</td>
<td>4.08 (1.49)*</td>
</tr>
<tr>
<td>24</td>
<td>5.30 (1.79)*</td>
<td>6.42 (0.93)*</td>
<td>3.16 (2.02)*</td>
</tr>
</tbody>
</table>

Enamel Adhesion, MPa(StDev)

<table>
<thead>
<tr>
<th>time (hr)</th>
<th>VBP</th>
<th>VB</th>
<th>FPP</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.25</td>
<td>4.89 (0.93)*</td>
<td>6.02 (2.02)*</td>
<td>3.26 (1.79)*</td>
</tr>
<tr>
<td>1</td>
<td>4.89 (1.12)*</td>
<td>6.32 (0.93)*</td>
<td>5.10 (1.65)*</td>
</tr>
<tr>
<td>4</td>
<td>6.22 (1.78)*</td>
<td>5.81 (1.51)*</td>
<td>2.24 (2.46)*</td>
</tr>
<tr>
<td>24</td>
<td>6.73 (1.67)*</td>
<td>6.42 (1.23)*</td>
<td>3.67 (1.32)*</td>
</tr>
</tbody>
</table>

Conclusions: The RMGI materials exhibited immediate bond to dentin and enamel, which was equivalent to their final bond strength at 24 hr.

3M ESPE Summary

Aim of the study: Evaluate the dentin and enamel adhesion of glass ionomer liners during the first 24 hours after application.

Results of the study: The RMGI materials exhibited immediate bond to dentin and enamel, which was equivalent to their final bond strength at 24 hours.
Effect of CoJet Sandblasting on Fatigue Data for Y-TZP Ceramics

S.S. SCHERRER1, E. VITTECOQ2, F. DE MESTRAL2, M. CATTANI-LORENTE1, A. WISKOTT1, and J.A. GRIGGS3,
1Univ. of Geneva, School of Dental Medicine, Geneva, Switzerland, 2Univ. of Applied Sciences of Western Switzerland (HES-SO), Geneva, Switzerland, 3University of Mississippi Medical Center, Jackson, MS

The use of a tribochemical silica coating (CoJet (3M ESPE), 30 micron alumina-silica coated particles) enhances the adhesion of resin cements to Y-TZP. The question is whether or not CoJet sandblasting does affect the fatigue limits and cumulative survival of Y-TZP ceramics.

Objectives: Determination of fatigue limits (Woehler’s diagram, WD) and Kaplan-Meier cumulative survival (KM) for four Y-TZP ceramics before (control) and after CoJet sandblasting.

Methods: (N>15) bars of 3 x 5 x 40 mm with bevelled edges were machined with similar surface roughnesses by the manufacturers for Zeno (Wieland) (ZW), Everest ZS (KaVo) (KV), Lava white (LV) and Lava brown (LVB) (3M ESPE). A surface of 5 x 6 mm² was sandblasted (s) in the middle of the tensile side of the zirconia bars for comparison. Cyclic fatigue (sinusoidal loading/unloading at a frequency of 10 Hz, amplitude of 90%) in water was performed in a 3-point-bend jig. Stress levels were lowered from the initial static value until surviving 1 million cycles. Kaplan-Meier (KM) cumulative survival graphs before and after sandblasting were plotted for comparison. The statistical analyses were performed using the log-rank test. A search for the critical flaw was performed by SEM on the fractured surface for all failed specimens.

Results: The median survival stresses in MPa were: ZW(ctr)=549 (543–555), ZW(s)=619 (553–684), KV(ctr)=595 (581–609), KV(s)=681 (653–709), LV(ctr)=748 (742–754), LV(s)=908 (847–969), LVB(ctr)=635 (575–695), LVB(s)=822 (812–832). Log-rank tests were significantly different (p<0.001) for all sandblasted groups versus the as machined except for Zeno Wieland (p=0.317). Failures started from both intrinsic and machined flaws.

Conclusion: CoJet sandblasting did significantly improve the fatigue behaviour of three out of four Y-TZP ceramic materials and can therefore be recommended for adhesive cementation procedures. This study was supported in part by grants from SSRD and 3M ESPE.

3M ESPE Summary

Aim of the study: The aim of this study was to show the influence of CoJet™ System on shaded and unshaded Zirconia.

Result of the study: CoJet system shows in this study for one material no negative impact and three out of four Zirconia showed improved fatigue behaviour. CoJet system treatment could be recommended for preparing Zirconia for adhesive cementation.

Text and graphics above refer to branded products offered by various companies. For trademark information, see the back page of this brochure.
Polish Retention Comparison of Experimental and Commercial Restorative Composite Materials

Dental Products, St. Paul, MN

Objective: The objective of this work was to characterize the surface gloss and roughness of dental restorative materials after toothbrushing.

Methods: Atomic Force Microscopy (AFM), Optical Scanning (Wyko analysis), and gloss measurement of polished and toothbrushed surfaces were done. Materials which were tested included nanocomposite Filtek Supreme Plus Dentin/Enamel/Body Shade (FS DEB) and translucent shades (FST), microhybrids Tetric Evoceram (TEC), Premise (PM), and Esthet-X (EX), as well as an experimental nanocomposite material in the Dentin/Enamel/Body (EXP-DEB) and translucent shades (EXP-T). Five highly polished tiles of each material were toothbrushed for 6,000 strokes and the resulting gloss retention (GR) at 60˚ was measured by a micro-tri-gloss instrument. The same samples were then subjected to topographical study using an Atomic Force Microscope (AFM) operated in both contact and tapping mode.

Results: The table below shows the GR at 6,000 strokes of toothbrushing, measured at 60˚.

<table>
<thead>
<tr>
<th>Sample</th>
<th>FS DEB</th>
<th>FST</th>
<th>TEC</th>
<th>PM</th>
<th>EX</th>
<th>EXP-DEB</th>
<th>EXP-T</th>
</tr>
</thead>
<tbody>
<tr>
<td>GR at 6,000</td>
<td>66.415</td>
<td>71.038</td>
<td>27.850</td>
<td>45.488</td>
<td>57.368</td>
<td>76.440</td>
<td>77.954</td>
</tr>
<tr>
<td>Standard Deviation</td>
<td>3.526</td>
<td>1.635</td>
<td>2.500</td>
<td>2.388</td>
<td>3.947</td>
<td>2.861</td>
<td>0.483</td>
</tr>
</tbody>
</table>

Conclusions: ANOVA analysis showed that at p<0.05, both of the experimental nanocomposite materials EXP-DEB and EXP-T had statistically higher gloss retention after toothbrushing than any of the other materials tested. Also at p<0.05 FST had higher gloss retention than FS DEB. Finally, all four of the nanocomposite materials (FST, FS DEB, EXP-DEB and EXP-T) had at p<0.05 higher gloss retention than any of the microhybrid materials tested. AFM images and Wyko analysis were used to image these differences and generate roughness values, as well.

Polish Retention

3M ESPE Summary

Aim of the study: To compare polish retention of an experimental nanocomposite (3M ESPE) to a currently marketed nanocomposite (3M™ ESPE™ Filtek Supreme Plus Universal Restorative) and various micro-hybrid composites.

Results of the study: The polish retention of the experimental nanocomposite was statistically higher than all other materials tested. The polish retention of the nanocomposite materials were statistically higher than the micro-hybrid composites.
Evaluation of Elipar™ S10 Regarding Five Seconds Curing Time

J. GRAMANN, O. KAPPLER, E. MECHER, W. WEINMANN, M. HOARAU-KURTZ, O., ALTHOFF, and C. THALACKER, 3M ESPE AG, Seefeld, Germany

Objectives: The aim of this study was to evaluate the curing performance of 3M ESPE Elipar S10 LED curing light prototype in its five seconds high speed curing mode by means of depth of cure (DOC).

Methods: DOC was measured according to DIN EN ISO 4049, 2001-01 (ISO 4049) with thirteen composite materials in shade A3, 5 or equivalent (see table). Each material (n=3) was cured for five seconds. The mean DOC values were compared with the increment thickness specified by the manufacturer’s instructions and calculated according to ISO 4049. Statistical analysis was done by one-way ANOVA (p<0.05).

Results: All tested restorative materials with shades A3, 5 and lighter showed statistically significant higher DOC than required by ISO 4049.

Conclusions: 3M ESPE Elipar S10 curing light S10 sufficiently cured all composites tested (shade A3, 5 or equivalent) in five seconds according to ISO 4049, which requests to position the curing light in close proximity to the composite during curing.

3M ESPE Summary

Aim of the study: This study evaluated the curing performance of Elipar™ FreeLight Curing Light S10 in its five seconds high speed curing mode by means of depth of cure.

Results of the study: Elipar FreeLight curing light S10 sufficiently cured all composites tested (shade A3, 5 or equivalent) in five seconds according to ISO 4049.
A Clinical Trial of Composite Restorations with or without Bevel


Objectives: The aim of this study was to make a controlled, double-blind and randomized clinical trial about composite resin restorations in posterior teeth with or without bevel.

Methods: It was made 29 composite restorations, being 14 without bevel (butt joint) and 15 with marginal beveling. All teeth were restored with Filtek P60 (3M ESPE) composite resin and Adper Single Bond (3M ESPE) dentin – Bonding agent. Restorations were performed by four calibrated operators and were analyzed first just after they were done (Baseline) and after 6 months by a calibrated evaluator (Kappa), according FDI criteria. It was used five scores for each criteria: Clinically excellent/very good, Clinically good, Clinically sufficient/satisfactory, Clinically unsatisfactory and Clinically poor.

Results: The results were statistically analyzed by chi-square and Fisher’s exact test (p<0.05), and didn’t show any difference between beveled and non-beveled restorations, in relation to: fractures and retention, marginal adaptation, postoperative hypersensitivity, recurrence of caries, surface luster and anatomic form. However, for surface and marginal staining, beveled restorations showed significant better performance than butt joints.

Conclusions: It was concluded that beveled restorations reduced surface and marginal staining for 6-months evaluation. None restoration failed in this time of period.

3M ESPE Summary

Aim of the study: Determine clinical performance of bevel vs non-bevel preparations in posterior composite restorations (Filtek™ P60 Restorative/Adper™ Single Bond 2 Adhesive).

Result of the study: Less surface and marginal staining was found in restorations with bevelled cavosurface preparations.

Text and graphics above refer to branded products offered by various companies. For trademark information, see the back page of this brochure.
Bond Strengths of a Low Shrink Composite to Various Substrates

G. GETZ, University of North Carolina, Chapel Hill, NC, R. WALTER, University of North Carolina, Chapel Hill, NC, E.J. SWIFT, Jr., University of North Carolina, Chapel Hill, NC

Objective: The purpose of this study was to evaluate the shear bond strength (SBS) of a novel low-shrink posterior composite (Filtek LS, 3M ESPE) to various substrates.

Methods: Filtek LS was bonded using its dedicated self-etching primer adhesive (LS System Adhesive) to dentin, ground enamel, resin-modified glass ionomer liner (Vitrebond, 3M ESPE), conventional glass ionomer restorative material (Fuji IX, GC America), and dentin previously exposed to zinc oxide-eugenol (IRM, Dentsply Caulk). Sixty extracted bovine teeth were assigned to groups (n=10) and ground to 600-grit. In the zinc oxide-eugenol group, IRM was applied to the dentin and removed after 10 days, prior to bonding. Vitrebond and Fuji IX substrates were fabricated by filling standardized preparations that had been made in epoxy resin. No tooth substrate was involved. As controls, Adper Scotchbond SE/Filtek Z250 (3M ESPE) was bonded to the same substrates. Adhesives and composites were applied according to manufacturer’s directions. Composites were applied using the Ultradent jig. The bonded specimens were stored in water at 37°C for 24 hr, and SBS testing was done using an Instron universal testing machine. The data were analyzed using ANOVA and Fisher’s PSLD test at a significance level of 0.05.

Results: Mean SBS (MPa ±SD) are presented in the table:

<table>
<thead>
<tr>
<th>Substrate</th>
<th>Adper Scotchbond SE/Filtek Z250</th>
<th>Filtek LS system</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dentin</td>
<td>31.5 (8.3)ª</td>
<td>25.9 (6.3)ª</td>
</tr>
<tr>
<td>Enamel</td>
<td>26.0 (9.1)ª</td>
<td>25.9 (6.3)ª</td>
</tr>
<tr>
<td>Vitrebond</td>
<td>25.6 (8.3)ª</td>
<td>24.6 (3.7)ª</td>
</tr>
<tr>
<td>Fuji IX</td>
<td>19.6 (5.9)ª</td>
<td>16.1 (7.6)ª</td>
</tr>
<tr>
<td>Dentin after IRM</td>
<td>19.1 (6.5)ª</td>
<td>17.2 (10.4)ª</td>
</tr>
</tbody>
</table>

Different superscript letters within a column represent significant difference.

Conclusions: The bond strengths of LS System Adhesive/Filtek LS to various substrates are comparable to those of Adper Scotchbond SE/Filtek Z250. Bonding of both systems to dentin was compromised by previous exposure of the dentin to zinc oxide-eugenol.
Degradation Resistance for Silorane, Ormocer and Dimethacrylate-Based Dental Composites

N. Silikas, L.M. Cavalcante, L.F. Schneider, and D.C. Watts, University of Manchester, Manchester, United Kingdom

Objectives: To evaluate the surface integrity resistance, water sorption (Wsp), water solubility (Wsl) and color stability (ΔE) as a function of time for dimethacrylate, Ormocer™ and Silorane™ based dental composites. The hypothesis tested was that Ormocer™ and Silorane™ would demonstrate similar stability than dimetacrylate based dental composites.

Methods: Four materials were evaluated: Filtek Silorane (3M/ESPE), experimental Ormocer™ (Voco), Grandio (Voco) and ELS Low Shrinkage (Saremco). Disc-shape samples (n=6) were prepared. All samples were photoactivated (40 s × 550 mW/cm²) with halogen source (Optilux 501, Demetron).

Surface integrity resistance was evaluated by Knoop indentations before and after water baths; Wsp and Wsl was adapted from ISO4049 and color and with a color meter using the CIELab method. Hardness and color tests were performed until maximum water uptake was achieved (24 days). The results for each test were analyzed with One-Way ANOVA followed by Student-Newman-Keuls post-hoc test (p=0.05).

Results: Filtek Silorane exhibited lower water solubility and Knoop hardness decrease than the other materials.

<table>
<thead>
<tr>
<th>Material</th>
<th>Wsp</th>
<th>Wsl</th>
<th>% of Knoop hardness decrease</th>
<th>ΔE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Silorane</td>
<td>14.88±1.12 b</td>
<td>1.39±0.06 d</td>
<td>7±3 b</td>
<td>1.9±0.5</td>
</tr>
<tr>
<td>Ormocer</td>
<td>17.81±0.90 a</td>
<td>6.47±0.55 b</td>
<td>19±4 a</td>
<td>1.7±0.4</td>
</tr>
<tr>
<td>ELS</td>
<td>18.04±0.72 a</td>
<td>10.97±1.81 a</td>
<td>—</td>
<td>1.3±1.2</td>
</tr>
<tr>
<td>Grandio</td>
<td>14.50±0.42 b</td>
<td>4.24±0.56 c</td>
<td>20±5 a</td>
<td>1.7±0.4</td>
</tr>
</tbody>
</table>

Conclusion: The hypothesis was not accepted. Filtek Silorane seems to have higher degradation resistance than the other materials tested.

Water sorption, water solubility, hardness decrease and color stability

3M ESPE Summary

Aim of the study: This study evaluated 3M™ ESPE™ Filtek™ Silorane Restorative and methacrylate-based filling materials for their resistance against degradation.

Results of the study: Filtek Silorane showed the best degradation resistance of the materials tested as represented by the lowest water sorption, the lowest water solubility and the lowest decrease in hardness.
In vitro Study of Composite Insertion Techniques on Cuspal Deflection

S. JAFAR-POUR, W. EL-BADRAWY, and D. MCCOMB, University of Toronto, Toronto, ON, Canada

Objective: The objective of this study was to investigate by simulation the effect of composite resin insertion techniques on cuspal deflection using bonded typodont artificial teeth and also to determine the effect of a new low shrinkage composite.

Methods: Sixty standardized MOD preparations on ivorine maxillary premolars were prepared - Group A at 4 mm depth and Group B at 6 mm depth. Each group was further subdivided according to composite insertion technique: 1. bulk insertion, 2. horizontal increments, 3. tangential increments, and 4. a modified tangential technique. Preparations were microetched, acid-cleaned and bonded with adhesive resin to provide micromechanical attachment before restoration with a conventional composite (Spectrum TPH3 - Dentsply). Two additional sub-groups (4 mm and 6 mm depth) were restored in bulk using lowshrinkage (silorane) composite (Filtek LS 3M ESPE). All groups received the same total photopolymerisation time. Cuspal deflection was measured during the restorative procedure using two LVDT’s attached to a data acquisition system.

Results: The average cuspal deflections for Group A were 1) 40.17±1.18µm, 2) 25.80±4.98 µm, 3) 28.27±5.12 µm, 4) 27.33±2.42 µm. The deflections in Group B were 1) 38.82±3.64 µm, 2) 50.39±9.17 3) 55.62±8.16 µm, 4) 49.61+8.01. Cuspal flexure for the low shrinkage composite was 11.14±1.67 µm (4 mm depth) and 16.53±2.79 µm (6 mm depth). All insertion techniques using conventional composite caused cuspal deformation. In general, deeper preparations showed increased cuspal deflection (p<0.05). Cuspal movement using low shrinkage composite was significantly reduced (p<0.05).

Conclusions: It was possible to simulate cuspal flexure using mechanically bonded artificial teeth. All insertion techniques using conventional composite caused substantial cuspal movement. The low shrinkage material demonstrated significantly lower cusp deflection. Deeper cavity preparations demonstrated increased cuspal deflection.

3M ESPE Summary

Aim of the study: This study compared the cuspal deflection of a methacylate placed in bulk and with various incremental techniques with Filtek™ Silorane Restorative placed in bulk.

Results of the study: Filtek Silorane restorative placed in bulk showed significantly lower cuspal deflection than Spectrum TPH3 even when placed using different layering techniques.
Influence of Polymerization Shrinkage and Contraction Stress on Marginal Adaptation

S. KRIFKA, M. FEDERLIN, M. ASENKERSCHBAUMER, C. BAUTINGER, A. REHMANN, K.-A. HILLER, and G. SCHMALZ, University of Regensburg, Regensburg, Germany

Objectives: In the present study the influence of different polymerization shrinkage (PS) and contraction stress (CS) in a group of methacrylate- and silorane-based composite resins on marginal integrity of respective Class V-restorations is tested.

Methods: In 336 standardized Class V-cavities either an etchant (Total Etch, Vivadent) or an adhesive (AdheSE One, Vivadent or Silorane System Adhäsiv, 3M ESPE) were applied. The cavities (n=12) were filled with composite resin of a wide range of PS and CS: els (EL) and els flow (EF) Saremco, Tetric EvoCeram (TC) and Flow (TF) Vivadent, Grandio (GR) Voco, Filtek Silorane (SI) 3M ESPE and Ultrasel XT Plus (US) Ultradent. Marginal adaptation was assessed by dye penetration (silver staining) on multiple sections with/without thermomechanical loading (TCML: 5,000 x 8°C–55°C; 30s/cycle; 500,000 x 72.5N, 1.6Hz). Data were statistically analysed with the Mann Whitney U-test and the Error Rates Method (ERM).

Results: Dye penetration (%); PS (Vol%); CS (MPa); Median (25%/75% percentiles) Marginal integrity, in general (ERM), was statistically significantly influenced by PS and CS. However a better marginal adaptation with decreasing PS or CS could not be observed. SI (least PS and low CS) yielded the lowest dye penetration after TCML.

Conclusions: Marginal integrity, in general (ERM), was statistically significantly influenced by PS and CS. However, a better marginal adaptation with decreasing PS or CS could not be observed. SI (least PS and low CS) yielded the lowest dye penetration after TCML.

3M ESPE Summary

Aim of the study: In this study Filtek™ Silorane Restorative was compared with several methacrylate composites for marginal integrity in Class V cavities.

Results of the study: Filtek Silorane restorative showed the least polymerization shrinkage and the lowest dye penetration after thermomechanical loading of all materials tested.

Results found in abstracts for Filtek™ Silorane Restorative also apply to products registered under the following name(s): Filtek™ LS Low Shrink Posterior Restorative and Filtek™ P90 Posterior Restorative.
Objective: In this study the clinical performance of a new low-shrink Silorane-based filling material (Filtek Silorane) and a methycrylate-based composite (Grandio) was evaluated in class II restorations.

Methods: Thirty-seven patients (40.6 ± 13.1a) received at least one pair of class II restorations (n=102 in total) in a randomized way. Two comparable cavities were filled with either Filtek Silorane/Silorane System Adhesive (3M ESPE) or Grandio/ Futurabond NR (VOCO) according to manufacturers’ instructions. After 12 months, restorations (n=97, 95% recall) and the clinical situation were evaluated (examiner-blinded) according to the new evaluation criteria of Hickel et al. (Clin Oral Investig 2007;11:5–33) establishing a new score-range of 1–5 (1–3 clinically acceptable, 4–5 clinically not acceptable). In addition enamel cracks were recorded. Statistical analysis was carried out with the Wilcoxon-test (Bonferroni adjustment).

Results: Scores (1/2/3/4/5 [%]) were: Surface luster: Silorane (35/63/2/0/0), Grandio (16/80/4/0/0), Surface staining: Silorane (81/17/0/2/0), Grandio (86/14/0/0/0), Color stability/translucency: Silorane (29/54/17/0/0), Grandio (20/60/20/0/0), Anatomical form: Silorane (65/29/6/0/0), Grandio (57/43/0/0/0), Fractures and retention: Silorane (96/0/2/2/0), Grandio (98/2/0/0/0), Marginal adaptation: Silorane (50/48/2/0/0), Grandio (61/37/2/0/0), Wear: Silorane (52/44/4/0/0), Grandio (37/63/0/0/0), Contact point: Silorane (81/2/17/0/0), Grandio (86/2/12/0/0), Patients’ view: Silorane (90/4/4/2/0), Grandio (94/4/2/0/0), Hypersensitivity/tooth vitality: Silorane (92/2/6/0/0), Grandio (86/6/8/0/0), Tooth integrity: Silorane (48/44/8/0/0), Grandio (47/49/4/0/0), Periodontal response: Silorane (60/23/17/0/0), Grandio (49/24/27/0/0), Oral health: Silorane (79/17/4/0/0), Grandio (78/18/4/0/0). No recurrent caries was recorded in both groups. The enamel crack index was added up to 0.06 for the Silorane group and 0.07 for the Grandio group.

Conclusion: Both restoratives did not show any statistical significant differences in their clinical performance so far. Therefore, after one year, Filtek Silorane was found to be efficacious in clinical use.

This study was supported by 3M ESPE, Seefeld, Germany.

3M ESPE Summary

Aim of the study: In this study Filtek™ Silorane Restorative was compared with a methacrylate composite for clinical performance in class II cavities.

Results of the study: Filtek Silorane restorative showed efficacious clinical results compared to a traditional methacrylate-based composite system.
Microleakage of Class II Composites with a Novel Bonding Technique

M. ALSALEH, O. EL-MOWAFY, L. TAM, and A. FENTON, University of Toronto, Toronto, ON, Canada

Purpose: This study determined microleakage of Class II composite restorations when lined with new self-adhesive resin-cements as bonding agents.

Methods: Fifty-four caries-free extracted molars were sterilized, mounted in acrylic bases, and divided into six equal groups according to adhesive used: RXU (RelyX Unicem, self-adhesive, 3M ESPE), MON (Monocem, self-adhesive, Shofu), BRZ (Breeze, self-adhesive, Pentron), PAN (PanaviaF-2.0, resin-cement with self-etch primer, Kuraray), FLS (Filtek-LS, newly-introduced silorane-based composite with self-etch primer, 3M ESPE), and as control SBMP (Scotch Bond Multipurpose, 3M ESPE). Class II (MOD) cavities were prepared with gingival floors located on dentin at one side (1.0 mm below CEJ), and on enamel at other side (1.0 mm above CEJ). A Thin layer of adhesive was applied onto all cavity walls and cavo-surface margins. Composite (Filtek Z250, 3M ESPE) was used to restore all preparations except FLS group. Specimens were stored in distilled water at 37˚C for 7 days and subjected to 1,000 thermo-cycles between 5˚C–55˚C. All Teeth surfaces except the restorations’ margins were sealed with nail varnish and were immersed in 2% procion-red solution for 24 hr at 37˚C. Teeth were then sectioned mesio-distally and die penetration assessed by two independent observers according to a five-point scale. Data were statistically-analyzed with Kruskal-Wallis test (P<0.05).

Results: Means of microleakage scores in dentin and enamel interfaces were: FLS (0, 0.4), RXU (0.6, 0.7), BRZ (0.6, 1), SBMP (3.3, 0.8), PAN (3.5, 3.1) and MON (4, 4). Kruskal-Wallis revealed significant differences among groups (P<.0001). FLS group showed the least microleakage among all groups at both enamel and dentin margins, followed by RXU and BRZ groups. Highest microleakage scores were recorded with MON and PAN groups.

Conclusions: Two self-adhesive resin cements (RXU & BRZ) and one self-etch primer (FLS) would be expected to result in minimal or no microleakage when used in restoration of Class II cavities with composite. Acknowledgements: 3M ESPE, Pentron, Shofu, Kuraray.

3M ESPE Summary

Aim of the study: Resin cements and adhesives were compared regarding their tendency for microleakage in Class II cavities.

Results of the Study: Filtek™ Silorane Restorative together with RelyX™ Unicem Cement showed the least leakage of the materials tested.
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Universidade Estadual De Ponta Grossa, Ponta Grossa–Paraná, Brazil

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G.C. LOPES, A. CORRÊA, and G.M. OLIVEIRA.  
Universidade Federal De Santa Catarina, Florianópolis–SC, Brazil

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University of São Paulo, São Paulo, Brazil
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N. SARTORI, R. BELLÌ, J.C. GUMMARÀS, G.A.C.D. ANDRADA, and S. MONTEIRO JR., *Universidade Federal de Santa Catarina, Florianópolis, Brazil, 1Universidade Federal De Santa Catarina, Florianópolis-SC, Brazil, 2Univesidade Federal de Santa Catarina, Florianópolis, Brazil, 3Brazil, 2University of Illinois–Chicago, Chicago, IL

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E. MOBARAK, University of Cairo, Cairo, Egypt, W. EL-BARAKYY, University of Toronto, Toronto, ON, Canada, and H. JAMJOOM, University of King Abdulaziz, Jeddah, Saudi Arabia

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R. ANDERS, J. CHEUK, S. THERIOT, A. FALTER, and N.K. SARKAR, Louisiana State University School of Dentistry, New Orleans, LA, 2Vetsartis Affairs Medical Center, Mandeville, LA, 3University of New Orleans, New Orleans, LA

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J. ELLAKURA, R. TRIANA, A. GARCIA, I. SANCHEZ, I. SOLES, F. CALVO, M. LARTITEGUI, and N. MINGUEZ, University of the Basque Leioa, Spain

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R.M. BARRETO, L. SALVIO, and I.O. SALGADO, Universidade Federal De Juiz De Fora, Juiz de Fora—Minas Gerais, Brazil, 2Universidade Federal De Juiz De Fora, Juiz de Fora—Minas Gerais, Brazil

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M.J.M.C. SANTOS, Universidade Federal Da Bahia, Salvador, Brazil, G.P. FREITAS, Universidade Federal Da Bahia, Salvador—Ba, Brazil, A.P. FREITAS, Universidade Federal Da Bahia, Salvador, Brazil, G.C. SANTOS-JUNIOR, University Western Ontario, London ON, Canada, and A.S. RIZKALLA, University of Western Ontario, London Ontario, Canada

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C.L. MIYAZAKI, M. PREVIDELLI, I.S. MEDEIROS, Y. KAWANO, and L.E. RODRIGUES FILHO, Universidade de São Paulo, São Paulo, Brazil

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M.R. GALVÃO, F.F. JASSE, A.N.S. RASTELLI, V.S. BAGNATO, J.R.C. SAAD, and M.F. DE ANDRADE, *Universidade de São Paulo State—UNESP, Araquara School of Dentistry, Araquara, Brazil, 2University of São Paulo State—UNESP, Araquara School of Dentistry, Araquara, Brazil, 3University of São Paulo—USP, Physics Institute of São Carlos, São Carlos—SP, Brazil

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M. IRIE, Y. TAMADA, Y. MARUO, G. NISHIGAWA, M. OIKI, S. MINAGI, K. SUZUKI, and D. WATTS, *Okayama University Graduate School of Medicine, Dentistry and Pharmaceutical Sciences, Okayama, Japan, 2Okayama University Hospital, Okayama, Japan, 3University of Manchester, Manchester, United Kingdom

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A. ABO EL NAGA, D. ABOU EL-MAGD, W. EL BADRAWY, and R. HAFEZ, ‘Misor University for Science and Technology, Cairo, Egypt, ‘Cairo University, Cairo, Egypt, ‘University of Toronto, Toronto, Canada

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H.W. ROBERTS, USAF Dental Evaluation and Consultation Service, Great Lakes, IL, D.G. CHARLTON, Naval Institute for Dental and Biomedical Research, Great Lakes, IL, and D.H. PASHLEY, Medical College of Georgia, Augusta, GA

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A. NAPOLES, USAF, Minot AFB, ND, and K. VANDEWALLE, USAF, Lackland AFB, TX

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Resin-Rich Interfaces Modify Stressing Patterns in an Incrementally Layered Resin-Based-Composite  
N. RAVAL, K. DARBY, W. PALIN, and O. ADDISON, University of Birmingham, Birmingham, United Kingdom
Rosin-based fluoride varnish products applied to tooth surfaces release fluoride ions over extended periods of time. Some fluoride varnish products may set quickly and remain only where applied, while other products may flow or migrate to untreated tooth surfaces post-application.

**Objective:** The aim of this study was to quantitatively evaluate the migration of three rosin-based fluoride varnish products from treated to non-treated tooth surfaces at 1 hr and 4 hrs post-application.

**Methods:** Adult volunteers (n=18) providing informed consent were enrolled into this IRB-approved clinical study. Treatments consisted of 0.1 g (0.104±0.017) of varnish applied to the buccal surface of eight anterior maxillary teeth. The study utilized a randomized, single-blind, three-treatment crossover design where all subjects received all test products. Each treatment period was preceded by a 48 hr (minimum) fluoride-restricted lead-in period to clear residual fluoride from the oral cavity. Migration data were captured as subjective, first-person assessments by study participants using a diagram of the dentition at baseline, within 2 min and at 1 hr and 4 hrs post-application. Products compared were: A) 3M™ ESPE™ Vanish™ 5% NaF White Varnish (OMNI/3M™ ESPE™), B) EnamelPro® (Premier Dental), and C) Varnish America™ (Medical Products Laboratories).

**Results:** Within 2 min of application, varnish was reported (mean±SD) on A) 8.00±5.05, B) 5.07±3.82, and C) 6.22±4.22 surfaces, with A>B=C (ANOVA, p<0.05). After 1 hr, varnish was reported on A) 10.14±3.74, B) 5.04±3.36, and C) 6.11±4.19 surfaces, with A>C=B. After 4 hrs, varnish was reported on A) 8.61±4.23, B) 4.54±3.33, and C) 5.42±4.16 surfaces, with A>C=B. At all timepoints, Product A was reported on significantly more lingual surfaces than the other test products.

**Conclusions:** Vanish was observed on a greater number of surfaces than the other varnish products after 2 min and up to 4 hrs post application. This suggests that Vanish exhibits superior migration from treated to untreated tooth surfaces than the other products tested.

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**3M ESPE Summary**

**Aim of the study:** To quantitatively evaluate the migration of three rosin-based fluoride varnish formulations across the dentition following application.

**Results of the study:** Vanish reached a greater number of tooth surfaces than the other fluoride varnish products immediately after application and continued to migrate for up to 4 hours. This *in vivo* study demonstrates that Vanish varnish exhibits enhanced flow characteristics compared to the other fluoride varnishes tested.

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Clinical Assessment of Remineralization from Fluoride Varnish Treatments

G.K. STOOKEY1, R.L. ISAACS2, M. MINAMI1, J. GE1, A.J. NUNEZ2, and D.A. ALLEN1, 1Therametric Technologies, Inc, Indianapolis, IN, 2Oral Health Research Institute, Indianapolis, IN

Background: A published report indicated that enamel fluorescence measurements could detect 20% differences in caries-preventive treatments in groups of 30–40 subjects within 6–12 months.

Objectives: The purpose of this double-blind longitudinal study was to determine the ability of a new fluorescence assessment instrument to detect the effect of a fluoride varnish on white spot lesions in a small group of children within a 6-month period.

Methods: Forty-eight children ages 7–17 were initially recruited; 47 subjects completed the study. All participants had two white spot lesions, resided in fluoridated communities, and were routinely using fluoridated dentifrices. Subjects were stratified by age and gender and randomly assigned to two groups that received a series of 4 weekly applications of either a fluoride varnish (Vanish) or a placebo varnish. The white spot lesions were independently examined clinically at baseline, 3 weeks, 3 and 6 months using non-invasive ICDAS criteria and fluorescence measurements performed with QLF and an early prototype of a new instrument, FluoreCam.

Results: None of the examination methods detected significant differences between groups in changes from baseline (increments) prior to 6 months. The results of the ICDAS and QLF exams after 6 months showed directional differences that were not statistically significant. However, the early prototype FluoreCam instrument detected a statistically significant difference between the treatment groups after 6 months with remineralization observed in the fluoride group and demineralization observed in the placebo group.

Conclusion: The use of the improved fluorescence assessment instrument permitted the detection of the ability of a fluoride varnish to remineralize incipient carious lesions in a small group of children within a 6-month test period. This research model may be useful for evaluating the cariostatic potential of innovative caries-preventive systems.

3M ESPE Summary

Aim of the study: Determine the ability of a new fluorescence assessment instrument to detect the effect of a fluoride varnish on white spot lesions in a small group of children within a 6-month period.

Results of the study: The use of the improved fluorescence assessment instrument permitted the detection of the ability of Vanish varnish to remineralize incipient carious lesions in a small group of children within a 6-month test period. This research model may be useful for evaluating the cariostatic potential of innovative caries-preventive systems.
Characterization of Enamel Remineralization via Polarized Light Microscopy

K.J. DONLY, University of Texas Health Science Center, San Antonio, TX, A.M. PFARRER, OMNI Preventive Care, A 3M ESPE Company, West Palm Beach, FL, R.P. RUSIN, 3M ESPE Dental Products, Saint Paul, MN, B. MOORE, 3M ESPE Dental Products, Saint Paul, MN, I. SASA, 3M ESPE Dental Products, Saint Paul, MN

Objectives: Characterize the remineralization behavior of enamel lesions after a toothbrushing regimen, where the lesion is treated with either a resin-based sealant applied as a coating over the lesion or an experimental resin-modified glass ionomer material applied adjacent to the lesion.

Methods: Extracted human molars with artificial caries-like lesions were sectioned longitudinally into 100 µm sections; photographed via PLM with imbibing media of water (nD=1.33; showing>5% porosity), followed by an imbibing media of Thoulet’s 1.41 solution (nD=1.41; showing>10% porosity). Acid-resistant varnish was applied to all surfaces, leaving only the external tooth surface with lesion exposed. Three treatments were applied: untreated control group (UNTR); Ultraseal XT™ Plus™ Pit and Fissure Sealant placed over the lesion (UXT); experimental resin-modified glass ionomer material EXM-713 placed adjacent to the lesion (EXM-ADJ). The sections were brushed with water daily for thirty days. The acid resistant varnish was removed; sections imaged via PLM again. The lesion body area was quantified with a computerized imaging system, and percent remineralization calculated from the lesion area before and after. The data were analyzed via one-way ANOVA and compared with Fisher’s T-test (p<0.05).

Results: Percent remineralization (stdev). Within each imbibition set, superscript letters denote groups that are not statistically different.

<table>
<thead>
<tr>
<th>Imbibition Set</th>
<th>n</th>
<th>Mean (StDev)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Water Imbibition</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>UNTR</td>
<td>9</td>
<td>10.08 (7.14)</td>
</tr>
<tr>
<td>UXT</td>
<td>9</td>
<td>2.96 (4.21)</td>
</tr>
<tr>
<td>EXM-ADJ</td>
<td>9</td>
<td>3.78 (3.62)</td>
</tr>
<tr>
<td><strong>Thoulet’s Imbibition</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>UNTR</td>
<td>10</td>
<td>1.51 (4.79)</td>
</tr>
<tr>
<td>UXT</td>
<td>10</td>
<td>7.08 (6.06)</td>
</tr>
<tr>
<td>EXM-ADJ</td>
<td>9</td>
<td>7.17 (7.70)</td>
</tr>
</tbody>
</table>

Conclusions: A resin-modified glass ionomer coating applied adjacent to an enamel lesion resulted in remineralization not statistically different from an untreated control and resin-based sealant applied over the lesion. This research was supported, in part, by 3M ESPE.

3M ESPE Summary

Aim of the study: Characterize the remineralization behavior of enamel lesions after a toothbrushing regimen, where the lesion is treated with either a resin-based sealant applied as a coating over the lesion or 3M™ ESPE™ Vanish™ XT Extended Contact Varnish (EXM-713) applied adjacent to the lesion.

Results of the study: Vanish XT (EXM-713) applied adjacent to an enamel lesion resulted in remineralization not statistically different from an untreated control and a resin-based sealant applied over the lesion.

Text and graphics above refer to branded products offered by various companies. For trademark information, see the back page of this brochure.

Ion release from a New Protective Coating


Objectives: Compare the ion release characteristics of an experimental coating material, EXM-713 (EXM), to a conventional glass ionomer sealant, GC Fuji™ Triage™ Capsule Radiopaque Glass Ionomer (FT) and a resin sealant, Pulpdent™ Embrace™ Wetbond™ Pit & Fissure Sealant (EW). EXM-713 is a resin-modified glass ionomer coating material.

Methods: 1 mm thick by 20 mm diameter disks were prepared following manufacturers instructions; each was immersed separately in 25 ml deionized water, stored at 37˚C. At 1 day, 7 day, 14 day, 30 day, 92 day, and 183 day the leachate solution was replaced with fresh deionized water. Calcium and phosphorous concentrations were measured via inductively coupled plasma atomic emission spectroscopy; fluoride concentration was measured with a fluoride ion specific electrode after addition of TISAB II buffer. Data were analyzed via one-way ANOVA and Tukey’s T-test (p<0.05).

Results: Cumulative ion release, µg(ion)/cm², is shown below (n=5). Within each time period and ion type, superscript letters denote groups that are not statistically different.

<table>
<thead>
<tr>
<th>Material</th>
<th>Material</th>
<th>Ion</th>
<th>1 day</th>
<th>7 days</th>
<th>14 days</th>
<th>30 days</th>
<th>92 days</th>
<th>183 days</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chuck</td>
<td>EXM</td>
<td>F</td>
<td>58.1(3.6)</td>
<td>134.4(7.7)</td>
<td>184.8(10.2)</td>
<td>244.4(12.4)</td>
<td>353.5(13.5)</td>
<td>449.3(18.5)</td>
</tr>
<tr>
<td>Fuji Triage</td>
<td>FT</td>
<td>F</td>
<td>46.7(11.9)</td>
<td>74.2(19.4)</td>
<td>89.6(22.5)</td>
<td>106.4(26.6)</td>
<td>140.2(33.0)</td>
<td>165.5(37.6)</td>
</tr>
<tr>
<td>Embrace Wetbond</td>
<td>EW</td>
<td>EW</td>
<td>38.9(0.6)</td>
<td>75.3(1.5)</td>
<td>87.9(3.0)</td>
<td>100.2(4.0)</td>
<td>117.9(5.0)</td>
<td>127.8(5.3)</td>
</tr>
<tr>
<td>Chuck</td>
<td>EXM</td>
<td>Ca</td>
<td>0.29(0.04)</td>
<td>0.67(0.29)</td>
<td>0.74(0.29)</td>
<td>0.96(0.30)</td>
<td>1.9(0.42)</td>
<td>3.9(0.55)</td>
</tr>
<tr>
<td>Fuji Triage</td>
<td>FT</td>
<td>Ca</td>
<td>0.13(0.11)</td>
<td>0.23(0.11)</td>
<td>0.28(0.12)</td>
<td>0.36(0.13)</td>
<td>0.46(0.17)</td>
<td>0.67(0.22)</td>
</tr>
<tr>
<td>Embrace Wetbond</td>
<td>EW</td>
<td>Ca</td>
<td>0.09(0.01)</td>
<td>0.18(0.03)</td>
<td>0.19(0.04)</td>
<td>0.19(0.05)</td>
<td>0.2(0.05)</td>
<td>0.22(0.07)</td>
</tr>
<tr>
<td>Chuck</td>
<td>EXM</td>
<td>P</td>
<td>17.36(2.89)</td>
<td>19.03(3.07)</td>
<td>19.50(3.11)</td>
<td>20.12(3.13)</td>
<td>23.66(3.06)</td>
<td>26.30(2.93)</td>
</tr>
<tr>
<td>Fuji Triage</td>
<td>FT</td>
<td>P</td>
<td>0.12(0.06)</td>
<td>0.12(0.06)</td>
<td>0.12(0.06)</td>
<td>0.12(0.06)</td>
<td>0.12(0.06)</td>
<td>0.35(0.14)</td>
</tr>
<tr>
<td>Embrace Wetbond</td>
<td>EW</td>
<td>P</td>
<td>86.09(3.03)</td>
<td>183.75(9.01)</td>
<td>217.68(13.40)</td>
<td>247.92(15.44)</td>
<td>283.73(18.16)</td>
<td>298.05(19.51)</td>
</tr>
</tbody>
</table>

Conclusions: At all times through 183 days the cumulative fluoride and calcium release of EXM was greater than FT and EW; and, FT and EW were not statistically different. The cumulative phosphorous release of EXM was higher than FT, and less than EW at all times. All three materials provide fluoride release over time; the experimental material EXM provides sustained release of fluoride, calcium, and phosphorous.

3M ESPE Summary

Aim of the study: Compare the ion release characteristics of 3M™ ESPE™ Vanish™ XT Extended Contact Varnish (EXM-713) to a conventional glass ionomer sealant and a resin sealant.

Results of the study: The cumulative fluoride and calcium release of Vanish XT (EXM-713) was greater than the resin sealant and the conventional glass ionomer sealant through 183 days; and, the resin sealant and the conventional glass ionomer sealant were not statistically different. The cumulative phosphorous release of Vanish XT was higher than the conventional glass ionomer, and less than the resin. Vanish XT provides sustained release of fluoride, calcium, and phosphorous.
Enamel Remineralization Behavior of Coating Materials via Polarized Light Microscopy

K.J. DONLY, University of Texas Health Science Center, San Antonio, TX, R.P. RUSIN, 3M ESPE Dental Products, Saint Paul, MN, A.M. PFARRER, 3M ESPE Dental Products, Saint Paul, MN, H. RIVERA, University of Texas Health Science Center, San Antonio, TX, I. SASA, University of Texas Health Science Center, San Antonio, TX

Objectives: Characterize the remineralization behavior of enamel lesions after a toothbrushing regimen, where the lesion is treated with either a rosin-based varnish applied as a coating over the lesion or an experimental resin-modified glass ionomer material applied adjacent to the lesion.

Methods: Extracted human molars with artificial caries-like lesions were sectioned longitudinally into 100 µm sections; then photographed via PLM with imbibing media of water (nD=1.33; showing>5% porosity), followed by an imbibing media of Thoulet’s 1.41 solution (nD=1.41; showing>10% porosity). Acid-resistant varnish was applied to all surfaces, leaving only the external tooth surface with lesion exposed. Three treatments were applied: untreated control group (UNTR); lesion coated with Colgate™ Duraphat™ Fluoride Varnish (DUR); experimental resin-modified glass ionomer material EXM-713 placed adjacent to the lesion (EXM-ADJ). The sections were brushed with water daily for thirty days. The acid resistant varnish was removed; sections imaged via PLM again. The lesion body area was quantified with a computerized imaging system. The percent remineralization was calculated from the lesion area before and after. The data were analyzed via one-way ANOVA and compared with Fisher’s T-test (p<0.05).

Results: Percent remineralization (stdev). Within each imbibition set, superscript letters denote groups that are not statistically different.

<table>
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<td>9</td>
<td>10.08 (7.14)a</td>
</tr>
<tr>
<td>DUR</td>
<td>10</td>
<td>2.39 (2.82)b</td>
</tr>
<tr>
<td>EXM-ADJ</td>
<td>9</td>
<td>3.78 (3.62)b</td>
</tr>
<tr>
<td><strong>Thoulet’s Imbibition</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>UNTR</td>
<td>10</td>
<td>1.51 (4.79)a</td>
</tr>
<tr>
<td>DUR</td>
<td>10</td>
<td>2.90 (2.71)b</td>
</tr>
<tr>
<td>EXM-ADJ</td>
<td>9</td>
<td>7.17 (7.70)a</td>
</tr>
</tbody>
</table>

Conclusions: A resin-modified glass ionomer coating applied adjacent to an enamel lesion resulted in enhanced remineralization compared to an untreated control; a conventional rosin-based fluoride varnish applied over the lesion was not statistically different from the control. This research was supported, in part, by 3M ESPE.

3M ESPE Summary

Aim of the study: Characterize the remineralization behavior of enamel lesions after a toothbrushing regimen, where the lesion is treated with either a rosin-based varnish applied as a coating over the lesion or 3M™ ESPE™ Vanish XT Extended Contact Varnish applied adjacent to the lesion.

Results of the study: Vanish XT applied adjacent to an enamel lesion resulted in enhanced remineralization compared to an untreated control; a resin-based varnish applied over the lesion was not statistically different from the control.
Clinpro™ 5000/1.1% Sodium Fluoride Anti-Cavity Toothpaste

In Vitro Assessment of Dentin Tubule Occlusion by Hypersensitivity Dentifrices

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Objective: The purpose of this study was to evaluate the in vitro occlusion of dentin tubules from fluoride-containing and fluoride-free hypersensitivity dentifrices, including two prototype NaF dentifrices containing a functionalized tricalcium phosphate (fTCP) technology, using a remin/demin cycling model.

Methods: 3 mm diameter bovine dentin specimens were ground, polished, and demineralized by immersion into 50% citric acid (pH=1.2) for 2 minutes (22°C). Baseline images were taken via reflective microscopy, and the images were scored on a scale of 1 (no occlusion) to 6 (complete occlusion). Specimens (N=10) were placed into the following groups: (A) DI water, (B) Crest Pro Health™ (1100ppm F), (C) 950ppm F prototype dentifrice w/ fTCP, (D) 5000ppm F prototype dentifrice w/fTCP, (E) fluoride-free SootheRx™, and (F) MI Paste PlusTM (900ppm F). The groups were cycled for 7 days in a remin phase consisting of three one-minute treatments (diluted 1:3 with DI water), followed by cycling for 3 days in a demin phase consisting of three one-minute treatments and three three-minute acid challenges (Coca-Cola®, pH=2.65). Between these events, specimens were immersed in artificial saliva. After cycling, the specimens were imaged and scored again by a blinded examiner and differences between the post-cycling and baseline scores were obtained.

Results: Mean±SD differences were (A) 1.55±1.7, (B) 0.7±0.9, (C) 3.98±1.1, (D) 4.33±0.6, (E) 3.61±0.7, and (F) 2.73±1.2, with A=B<F≤E≤C=D (ANOVA, SNK, p<0.05). Post-cycling reflective microscopy showed complete tubule occlusion with mineral layer formation for Groups C and D, considerable occlusion for Groups E and F, and virtually no occlusion for Groups A and B.

Conclusions: Based on these results, the model demonstrated sensitivity to formulations containing calcium. Since Groups C and D containing fTCP technology produced similar occlusion, these results appear to be independent of fluoride. In summary, the prototype NaF dentifrices containing fTCP show great promise for hypersensitivity benefits.

3M ESPE Summary

Aim of the study: Evaluate the antihypersensitivity potential of dentifrice formulations using a remin/demin pH-cycling model.

Results of the study: The model demonstrated sensitivity to formulations containing calcium. Clinpro™ Tooth Crème 0.21% w/w Sodium Fluoride Anti-Cavity Paste with Tri-Calcium Phosphate and Clinpro™ 5000 1.1% Sodium Fluoride Anti-Cavity Toothpaste dentifrice formulations exhibited promising antihypersensitivity potential.
Enzymatic Dentine Caries Removal System (SFC-V)

Enzymatic Dentine Caries Removal System in Class-V Carious Lesions

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Objective: Systems for caries removal and cavity preparation are developing towards minimal invasive procedures and increased patient comfort. Conventional caries removal involves the use of low-speed rotary instruments to remove carious dentine. In order to find alternative treatment procedures, a new enzymatic dentine caries removal technique has been developed to differentiate caries affected (remineralizable) from caries infected (non-remineralizable) dentine, preserve tooth structure and minimize the risk of pulp exposure.

Method: This prospective, randomized, controlled, examiner-blinded, clinical study was carried out to evaluate Class V-composite restorations after the treatment with a new enzymatic dentine caries removal agent (SFC-V, 3M ESPE) in vital teeth, in comparison to the conventional bur-treatment (32 patients, age 49.5±17.5, 37% female, 63% male). The study design allowed an evaluation of several aspects of a caries removal treatment procedure. Apart from the comparison of the remaining dentinal tissue after SFC-V or burtreatment, the primary objective was the performance of the restoration over time (Follow-up: 24–48 hours after intervention, 10+5 days after intervention, 6+1 months after intervention) with a conventional composite, according to the RYGE criteria.

Results: Scores [%] of the Ryge/CDA-evaluation for the two groups SFC-V/ Control were alpha, bravo, charlie and delta: Color match: SFC-V: Baseline (41/24/35/0), 6 Months (60/20/20/0), control: Baseline (53/47/0/0), 6 Months (40/53/7/0). Marginal discoloration: SFC-V: Baseline (94/6/0/0), 6 Months (93/7/0/0), control: Baseline (93/7/0/0), 6 Months (73/27/0/0). Marginal adaption: SFC-V: Baseline (100/0/0/0), 6 Months (82/12/0/6), control: Baseline (100/0/0/0), 6 Months (93/7/0/0). Secondary caries: SFC-V: Baseline (100/0/0/0), 6 Months (100/0/0/0), control: Baseline (100/0/0/0), 6 Months (100/0/0/0).

Conclusion: Preservations of affected dentin by excavation with SFC-V showed clinical results comparable to conventional caries excavation methods with regard to the performance of the restorations.

3M ESPE Summary

Aim of the study: In this clinical study in Class-V cavities, a new enzymatic dentine caries removal system (SFC-V) has been evaluated that aims to differentiate caries affected (remineralizable) from caries infected (non-remineralizable) dentine, preserves tooth structure and minimizes the risk of pulp exposure. Restoration performance was chosen as the primary clinical endpoint.

Results of the study: SFC-V showed clinical results comparable to conventional caries excavation methods with regard to the performance of the restorations.
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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.