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DENTAL ADVISOR™

Product insights you can trust.

CLINICAL TIE TO THE LAB

MAIN TOPIC: RESEARCH METHODS & EQUIPMENT AT DENTAL ADVISOR

HYDROGEN PEROXIDE TOOTHPASTE LABORATORY EVALUATION

OVERNIGHT TEETH WHITENING PEN LABORATORY EVALUATION

RECENTLY-DEVELOPED SINGLE-SHADE COMPOSITE

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Product insights you can trust.

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VOL. 41 NO. 3

FROM THE DESK OF
Dr. Sabiha S. Bunek
CEO & Editor-in-Chief

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At DENTAL ADVISOR, we have the unique ability to translate our materials research into clinically relevant data. Our state-of-the art laboratory provides independent analysis that is tailored for everyday dentistry, including explanations of benchmarks that can impact clinical outcomes. Our testing adheres to ISO, ADA, and ASTM standards, ensuring the reliability of our results. We are a trusted, independent third-party resource for manufacturers and distributors seeking to develop and enhance their products. Our scientific team often designs custom tests to verify the accuracy and significance of product claims for dental professionals, the end users. When combined with clinical evaluations, our recommendations to the dental community are aimed at truly improving patient care. As always, we welcome your feedback. Please feel free to reach out to me at drbunek@dentaladvisor.com or to our team at connect@dentaladvisor.com with any questions or concerns. Thank you for reading!

— Sabiha S. Bunek

CLINICAL EVALUATOR PROFILE

Dr. Frank A. Berman graduated from Wilkes University in 1971 with degrees in Psychology and Elementary/Secondary Education. He joined the Navy in 1970 and upon graduating in 1971 was commissioned as an Ensign. He completed flight training and received his gold Naval Aviator wings in 1972. After graduation from flight school, he was assigned to Patrol Squadron 46 at Moffett Field, California as a patrol plane commander of the P-3 Orion, the world's premier anti-submarine warfare aircraft. After this tour of duty with multiple deployments to the western Pacific and East Asia, taking part in the end of the Vietnam War, in 1976 he became the chief pilot of Naval Air Station Key West, Florida.

Though he left active duty in 1977, Frank stayed in the Naval Reserve as a P-3 patrol plane commander at Willow Grove Naval Air Station, Pennsylvania for the next 14 years, until his retirement as a Lieutenant Commander from the Navy in 1991. After leaving active duty, he subsequently flew commercial airliners for Allegheny Airlines in 1978, but found commercial aviation unfulfilling and entered Temple University Kornberg School of Dentistry, graduating in 1982.

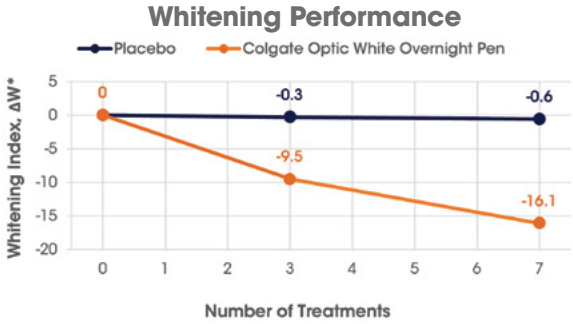
Frank has been in private practice in Northeastern Pennsylvania since his graduation in 1982 and has been a solo practitioner since 1984. His general dental practice in Kingston, PA treats patients of all ages, with an emphasis on cosmetic and reconstructive dentistry.

Frank has been a member of the Dental Advisor team since hearing Dr. Farah speak at a seminar in 1991. Frank's work with Dental Advisor has been an extremely rewarding venture for the last 33 years, having evaluated scores of outstanding dental products and meeting like-minded clinicians.

Frank has been married to Sally for 51 years, and they have two children. Jack works in the legal and compliance field at a private wealth management firm and Amy works for a large technology company as a senior intellectual property paralegal. Frank enjoys traveling with Sally, spending time with his children and their spouses, and is an avid golfer.

SPECTROPHOTOMETER TESTING

X-Rite VS3200 MetaVue Imaging Spectrophotometer



What it Does:

Tests color change and translucency of materials as well as shade match of composites, and ceramics. Non-contact imaging spectrophotometry allows sampling of 2 mm diameter of surfaces for precise measurements.

How This Applies Clinically:

The color matching and long-term performance of restoratives is a critical feature of patient acceptance. New single-shade and limited shade composites benefit from in-vitro testing to determine limitations and strengths for shade matching ability to inform clinical choices in composites for different procedures.

Example of Lab Testing Performed by DENTAL ADVISOR:

Whitening studies performed on ***Colgate® Optic White® Renewal Toothpaste*** and ***Colgate® Optic White® Overnight Teeth Whitening Pen*** (Colgate-Palmolive) showed significant improvement in whiteness levels on stained teeth in under a week of use.

TOOTHBRUSH ABRASION SIMULATOR

What it Does:

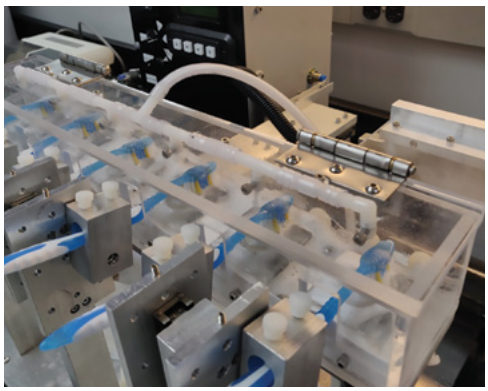
This simulates toothbrush use for long-term wear studies and short-term simulations. This can be used to measure the abrasivity of toothpaste & toothbrush combinations as well as gloss retention and wear of restoratives in combination with measuring surface roughness (profilometry).

How This Applies Clinically:

High gloss retention of composites allows restorations to maintain esthetics over time while also minimizing staining and bacterial adhesion. Characterizing toothpaste and toothbrush abrasivity is a common concern for the general population.

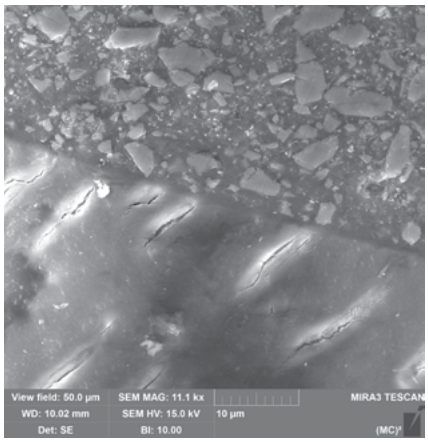
Example of Lab Testing Performed by DENTAL ADVISOR:

The Toothbrush Simulator was used to evaluate ***Panavia Veneer LC*** (Kuraray Noritake) and assess the long-term stability of its durability and esthetics under simulated brushing conditions. The spherical filler particles in the resin cement not only contribute to sustained gloss and esthetics along the margin over time but also improve flowability and film thickness, facilitating easy application.



MARGINAL GAP TESTING

X-Rite VS3200 MetaVue Imaging Spectrophotometer



What it Does:

Marginal gap assessment with SEM, MicroCT and dye penetration tests evaluate the integrity of the marginal seal.

How This Applies Clinically:

Marginal gap assessment under SEM and dye penetration tests indicate the risk potential associated for microleakage and secondary caries. These tests can evaluate the effects of technique or materials on the resultant leakage potential of clinical procedures.

Example of Lab Testing Performed by DENTAL ADVISOR:

Results of research of ***STELA*** (SDI Limited), a self-curing composite resin showed remarkably low incident of open margins and perfect dentin interfaces due to the lack of light polymerization required. This allows the polymerization stresses to be spread equally across the entire bonding interface of placed restorations. Extensive testing also showed great mechanical properties and this product features two different consistencies to cover all indications for direct composite placement, including core build-up.

MILLING & PRINTING ACCURACY OF CAD/CAM AND PRINTED MATERIALS

What it Does:

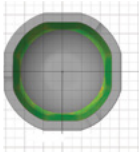
Tests the accuracy of machined and additively manufactured products compared to the original design file.

How This Applies Clinically:

Accurate restoratives, models and other products provide better fit which can reduce occurrence of marginal gaps, adjustments of occlusion, and the need to remake products.

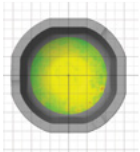
Machining Accuracy Discrepancy

Material	Intaglio Lateral, µm	External Lateral, µm	Intaglio Z-Direction, µm	External Z-Direction, µm	Prep-line, µm
Amber Mill	31 (25)	42 (20)	89 (22)	89 (26)	20 (50)

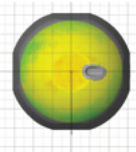


Specimen intaglio surface plane in the lateral direction.

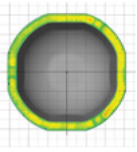
Specimen external surface plane in the lateral direction.



Specimen intaglio surface plane in the Z-direction.



Specimen external surface plane in the Z-direction.



Specimen prep-line surface in the Z-direction.

Example of Lab Testing Performed by DENTAL ADVISOR:

Amber Mill (Hass Bio) is a lithium disilicate block that may be used with or without heat treatment allowing the translucency to be customized from a single block. Machining accuracy testing showed high machining accuracy in the critical areas of the margin, intaglio and external lateral areas.

MICRO-CT ANALYSIS

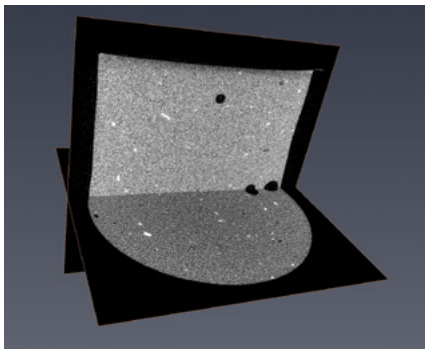
What it Does:

Non-destructive 3D imaging using x-rays of restorative procedures and materials including composites, ceramics, and endodontic procedures. This can provide quantifiable data on voids, marginal gaps, fit, canal transportation, remineralization, filler distribution, polymerization shrinkage and grain analysis of metal products.

How This Applies Clinically:

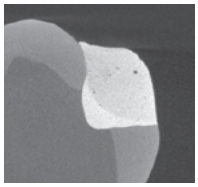
Voids can be quantified to provide insight into clinical technique and material properties. Marginal gap analysis provides insight into accuracy of fit of indirect restoratives or the effect of shrinkage stress on direct restoratives. Remineralization of tooth structure of varnishes or bioactive restoratives can be measured showing differences between products.

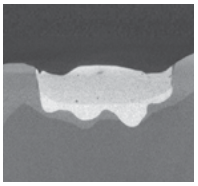
Composite MicroCT Orthoslice



Example of Lab Testing Performed by DENTAL ADVISOR:

BRILLIANT EverGlow (Coltene) in combination with ***BRILLIANT EverGlow Flow*** showed great synergy in a battery of tests including a MicroCT analysis of the adaptation to the bonding interface. The combination of using ***BRILLIANT EverGlow Flow*** as a base-liner allowed perfect adaptation to the tooth structure while providing a flexible base which can be capped with ***BRILLIANT EverGlow*** packable for resisting occlusal forces and wear.





REMINERALIZATION

What it Does:

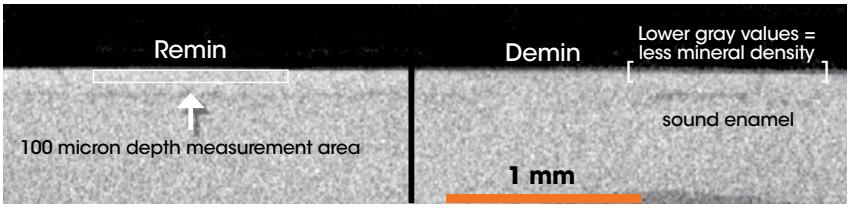
Artificial caries are produced in extracted teeth and then a remineralizing agent or restorative is applied. Differences in hardness, composition of calcium or phosphate, and radiodensity measured using a MicroCT technique can be compared to a control group to determine how well the product performs. Similar testing can also determine how well a varnish or other product protects teeth from acid or bacterial attack.

How This Applies Clinically:

Comparing the performance of different products in protecting and remineralizing teeth can aid in determining treatment approaches and material selection.

Example of Lab Testing Performed by DENTAL ADVISOR:

Testing of ***Ketac Universal*** (3M Oral Care), a Glass Ionomer Restorative, showed the benefit of remineralizing carious enamel by examining the hardness and radiodensity changes after 3 weeks of placement. ***Ketac Universal*** restored over half of the hardness and radiodensity lost due to demineralization of a 60 micron lesion.



Transverse cross-section of a demineralized enamel specimen, the left had glass ionomer applied, the right was covered by a varnish as a control

BOND STRENGTH & THERMOCYCLING

What it Does:

Shear Bond Strength is the ability of the bonding agent to adhere to both dentin and enamel, both immediately and over time. Bond strength measures the force needed to separate a material from a substrate, which assesses the strength of adhesion.

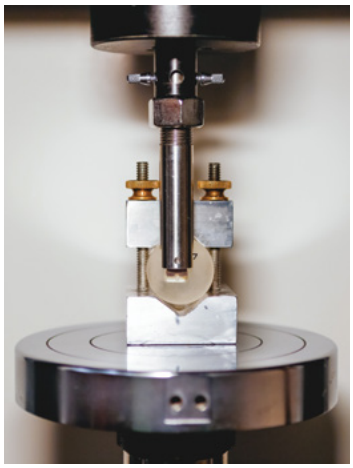
Thermocycling materials expose them to hot and cold baths and can mimic oral conditions and simulate advanced aging over different periods of time by stressing the bonding interface.

How This Applies Clinically:

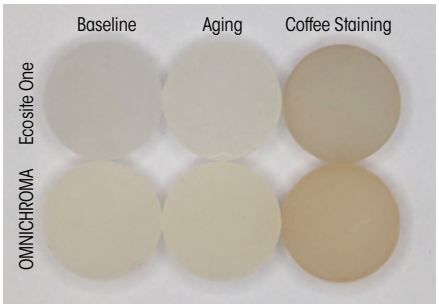
Bond strength data, both initial and after thermocycling, should be considered in the performance of materials intraorally. In general, the higher the numbers are, the more adhesive the product is. Performance of materials over time can be applied to reduced sensitivity and microleakage in practice.

Example of Lab Testing Performed by DENTAL ADVISOR:

In our lab study, ***G2-BOND Universal*** (GC America) performed better than ***CLEARFIL SE Bond 2*** and ***Optibond FL*** when tested in their respective etching modes to dentin and enamel in immediate 24-hour shear bond strength and after accelerated aging and 12-month storage.



COLOR STABILITY & STAIN RESISTANCE



What it Does:

Color stability and stain resistance testing examines the ability to maintain the original shade over time. Color stability measures the color change due to different light, color and temperature changes, while staining resistance measures the color change due to exposure to various liquids known to cause color change such as wine, coffee or soda.

How This Applies Clinically:

The ability of restorative products to maintain the same shade over time is of critical importance for esthetics. Measuring the differences between products can inform which products are more ideal in the anterior zone. A highly polished and well polymerized composite is also important to minimize color change over time.

Example of Lab Testing Performed by DENTAL ADVISOR:

Ecosite One (DMG America) is a new single-shade composite indicated for posterior use. It was subjected to accelerated aging in a weathering chamber and staining by coffee to simulate years of exposure and color properties were measured with a benchtop spectrophotometer. As a result, there was minimal change in translucency critical for maintaining the chameleon effect over time and acceptable color change which indicates the ability for lasting color matching.

POLISHABILITY & GLOSS RETENTION

What it Does:

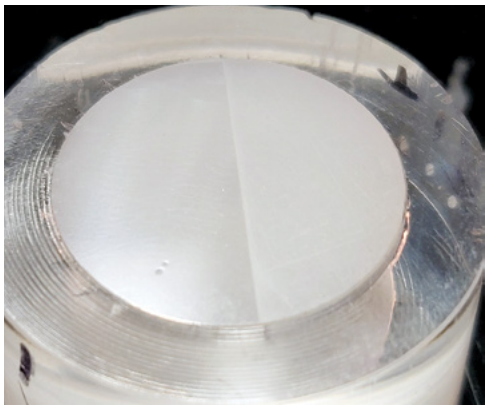
Polishability measures the speed and final result with which a restorative can be polished and gloss retention measures the ability to maintain the gloss after toothbrush abrasion, aging and staining.

How This Applies Clinically:

Maintaining a smooth outer surface of restoratives has many benefits including reducing bacterial adhesion and minimizing staining. Testing validating the combination of a specific polishing system and restorative can inform choices to optimize time spent polishing and final results.

Example of Lab Testing Performed by DENTAL ADVISOR:

CEREC MTL Zirconia (Dentsply Sirona) is a multi-layered CAD/CAM zirconia block and was evaluated for Polishability using ***Luster*** (Meisinger) polishers and was able to reach a mirror like finish in less than 60 seconds of polishing.



Example of a specimen after toothbrush abrasion, with the polished surface (~86 gu) on the left, and abraded surface (~63 gu) on the right.

DEPTH OF CURE

What it Does:

Depth of cure testing measures the extent that composites polymerize with a curing light exposure. This is often measured by using hardness indents at different intervals of depth from the surface to determine how the composite polymerized with different curing conditions. This can also be used to compare curing light performance.

Hardness indents every 0.5 mm measures composite depth of cure

How This Applies Clinically:

In-vitro testing is the only way to know how well a composite is going to cure with a given light exposure. Curing lights vary in output of wavelength, intensity, and beam uniformity which can have a massive effect on the polymerization of composites. Likewise, composites vary widely in how much energy is required to polymerize and the maximum depth they can be cured. Having data on specific combinations of composites and curing systems can inform the clinician of the duration of curing and effective depth in clinical procedures.

Example of Lab Testing Performed by DENTAL ADVISOR:

Monet Laser Curing Light (AMD Lasers) was extensively tested with several different bulk-filled composites. It was able to effectively cure them to a sufficient depth of cure in 3 seconds or less.

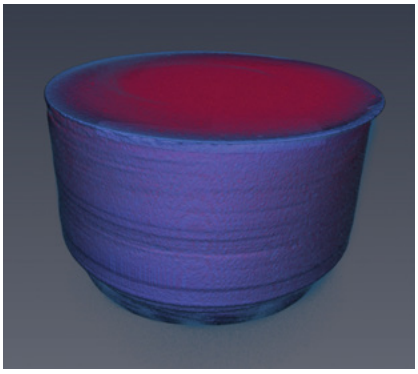
POLYMERIZATION SHRINKAGE

What it Does:

Polymerization shrinkage testing measures dimensional changes during curing of composite which can affect marginal leakage and stress at the bonding interfaces. Volumetric shrinkage measures the overall shrinkage of a composite, while shrinkage stress testing measures how much this shrinkage places stress at the bonding interfaces.

How This Applies Clinically:

Polymerization shrinkage of composites can induce enamel micro-fractures which often show as white lines at the margin, and debonding of dentin walls hidden from view which can lead to increased sensitivity and overall lower strength of the restoration. Composites with lower shrinkage in either volume or stress can lower the risk of debonding and leakage.



Micro-CT scans before and after polymerization with differences highlighted in red.

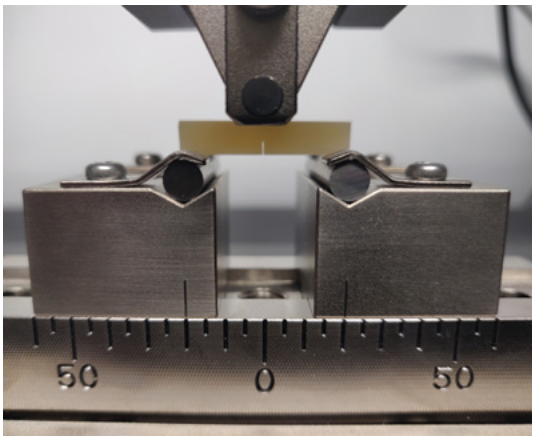
Example of Lab Testing Performed by DENTAL ADVISOR:

Fit SA (SHOFU) was extensively tested including polymerization shrinkage using a MicroCT scanner which accurately measured the volumetric shrinkage while also showing the benefit of the self-adhesive properties. All of the measured shrinkage occurred at the surface of the composite rather than at the bonded interface.

FRACTURE TOUGHNESS

What it Does:

Fracture Toughness measures the ability of a material to resist flaws or cracks from expanding and is one of the most closely related tests to chipping resistance. The most commonly tested materials are composites and ceramics.



How This Applies Clinically:

Fracture toughness is crucial for resistance to chipping and fracturing, thus prolonging restoration longevity. The ability of restoratives with microscopic flaws to resist propagating those flaws leading to fracture is one of the most important factors for determining if a product can resist occlusal forces long-term.

Example of Lab Testing Performed by DENTAL ADVISOR:

A test program including fracture toughness showed that ***3M Filtek Supreme Flowable*** (3M Oral Care) possessed material properties that rivals other packable composites in a project to assess the expansion of indications for this composite. Fracture toughness was an important component to show that it could resist occlusal forces and resist fracture propagation stresses.

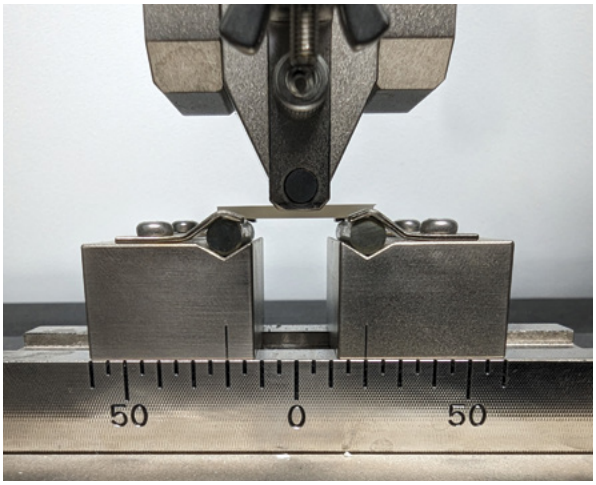
FLEXURAL STRENGTH & MODULUS

What it Does:

Flexural strength and modulus evaluates a material's strength and resistance to bending. All restoratives can be tested.

How This Applies Clinically:

Flexural strength testing is a way to compare all restorative materials by measuring how much force can be absorbed as the material flexes from mastication or impact. This is critically important for stress bearing areas such as posterior restorations. The modulus or stiffness of the material is related to how much give the material has on occlusal forces. A higher modulus is usually desirable for occlusal surfaces. Lower modulus materials are ideal for cavity liners and class V restorations in particular, but a low modulus won't necessarily preclude a material from being used in other indications based on the other properties.



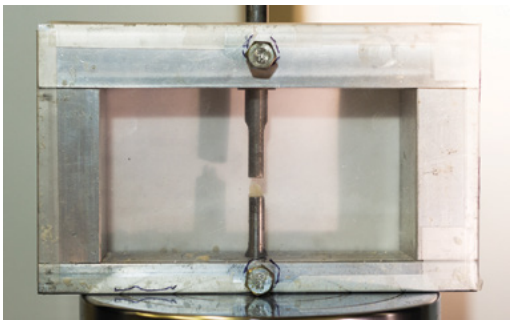
Example of Lab Testing Performed by DENTAL ADVISOR:

3M Filtek One Bulk Fill Restorative (3M Oral Care) is recognized as the strongest bulk-fill composite by DENTAL ADVISOR with flexural strength as high as 180 MPa, and also retained more of the flexural strength after water storage than other composites tested.

COMPRESSIVE STRENGTH

What it Does:

Compressive Strength measures the ability to withstand load-bearing forces without deformation. Higher compressive strength often correlates with greater resistance to breakage under force. All restoratives can be tested.



How This Applies Clinically:

This property is important for restoratives in regards to occlusal forces, especially in posterior regions, as well as load bearing restoratives such as core materials. This is also measured for other materials, such as dental stone, as the material must be strong enough to resist compressive forces when flasking and making models.

Example of Lab Testing Performed by DENTAL ADVISOR:

Beautiful II LS (SHOFU) is a composite formulated to minimize shrinkage and is also one of the strongest composites on the market at resisting compressive forces with a nearly 400 MPa compressive strength.

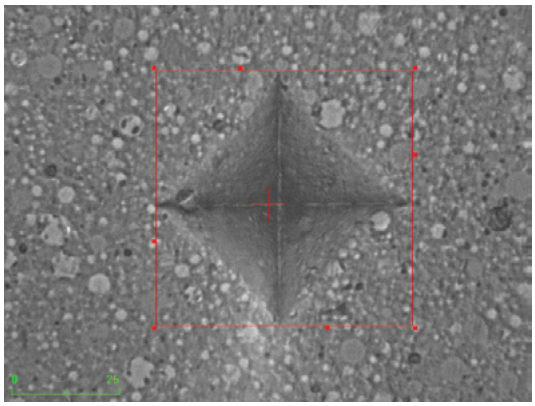
HARDNESS

What it Does:

Hardness measures resistance to indentation and is correlated with wear properties, polymerization percentage and modulus. Different hardness methods are used depending on the type of material.

How This Applies Clinically:

Hardness of materials is correlated to several properties, including wear, modulus as well as the polymerization of light-cured materials. Hardness is a predictor as to which materials can be used on occlusal surfaces. For composites, the threshold should mimic dentin at minimum, which is 80 HV.

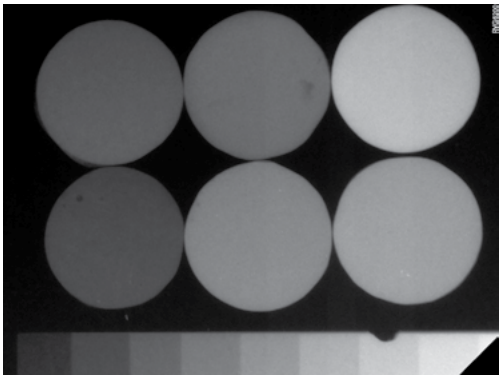


This is a Vickers indent. The larger the indent, the lower the hardness.

Example of Lab Testing Performed by DENTAL ADVISOR:

GrandioSO Heavy Flow (VOCO) is a notable composite for having one of the highest filler contents for a flowable composite which also measured the highest hardness of 98 HV for a syringeable composite.

RADIOPACITY



What it Does:

Measures how radiopaque restorative materials appear on radiographs compared to a standard Aluminum step wedge with thicknesses from 0.5 to 6 mm which is radiographically equivalent to dentin, while enamel is approximately 2 times more radiopaque compared to aluminum.

How This Applies Clinically:

Radiopacity is essential for detecting recurrent decay on radiographs, with ideally a radiopacity that clearly distinguishes the composite from tooth material. An ideal radiopacity for restorative materials is over 250% equivalent to aluminum to distinguish it from dentin (100%) and enamel (200%).

Example of Lab Testing Performed by DENTAL ADVISOR:

3M Filtek One Bulk Fill Restorative (3M Oral Care) is recognized as the strongest bulk-fill composite by Dental Advisor, and has an exceptional radiopacity equivalent to 310% of aluminum for clear radiographic visibility.

CUSTOM TEST: APPLICATOR TESTING

What it Does:

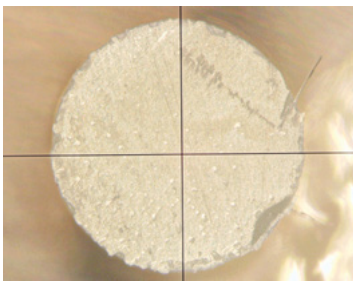
An SEM was used to see shedding of microscopic hairs or pieces of the brush contaminating the bonding layer. How well a microbrush takes up and delivers a bonding agent can be measured, as well as determining whether or not a microbrush absorbs any of the material leading to waste.

How This Applies Clinically:

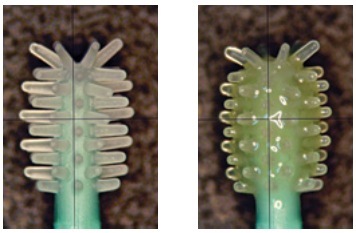
Not all brushes are created equal. Some pick up adhesive and apply it to the tooth structure better than others. The ability to effectively deliver adhesive to the tooth improves the application of a bonding agent and thus also improves marginal adaptation by evenly coating the tooth surface. A small, fine-tip applicator allows for precise placement of materials, reducing the risk of over-application or waste. Furthermore, non-linting, non-absorbent material minimizes the potential for contamination, ensuring the integrity of dental materials and maintaining aseptic conditions during procedures.

Example of Lab Testing Performed by DENTAL ADVISOR:

Testing of ***ZerofloX*** (Medmix Switzerland AG) involved both flowable composites and adhesives. Its design creates no risk of contaminating the bonding interface. Flock-Free elastomer bristles can be used with adhesives and achieve similar bond strengths as conventional micro brushes without worrying about contaminating the bonding interface. These brushes contributed to excellent marginal adaptation which in turn reduced the potential for microleakage, secondary caries, and failure of the restoration.

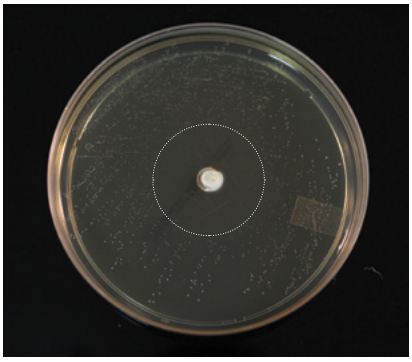


Bond strength specimen with microfiber embedded in bonding interface.



New *ZerofloX* flock-free elastomer applicator brush.

ZONE OF INHIBITION



Zone of inhibition (outlined) created by *Riva Star Aqua* when challenged to S. mutans.

What it Does:

This test measures the ability of a material to resist infiltration of bacteria associated with recurrent caries. It will quantify the area of bacterial resistance, showing the efficacy of the product.

How This Applies Clinically:

Utilizing a product with a good zone of inhibition will successfully combat oral bacteria which can lead to recurrent decay and or sensitive teeth.

Example of Lab Testing Performed by DENTAL ADVISOR:

Riva Star Aqua (SDI Limited) caused a larger zone of inhibition for all four of the challenge microorganisms when compared to ***FiteBac® Antimicrobial Cavity Cleanser***. Although more clinical studies are needed, this demonstrates that ***Riva Star Aqua*** could have significant impact on inhibiting bacterial growth in addition to desensitizing.

AEROSOL REDUCTION

What it Does:

Utilizing a bioaerosol capture device, air samples are taken and plated for microbial growth. Typically use of external suction or air purification can be tested against control conditions.

How This Applies Clinically:

If microbial counts are lower using devices such as HVE, external suction, or air purification, it is likely these methods are successful in delivering cleaner air and reducing bioaerosols.

Bioaerosol Sampler

Example of Lab Testing Performed by DENTAL ADVISOR:

The findings from this study showed trends of reduced airborne bacterial load when the ***Vaniman PURE BREEZE HEPA Air Purifiers*** (Vaniman) were in use during a busy practice workweek consisting of aerosol generating procedures.

WATERLINE TREATMENT EFFICACY

What it Does:

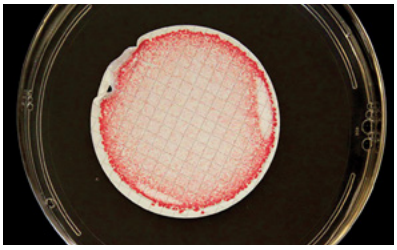
The technique tests the cleaning efficiency of waterline treatments that are used in dental practices. Water samples are gathered using a sterile technique and plated for microbial growth both before and after treatment with a waterline cleaner. Reduction in bacteria is measured to determine efficacy of the product.

How This Applies Clinically:

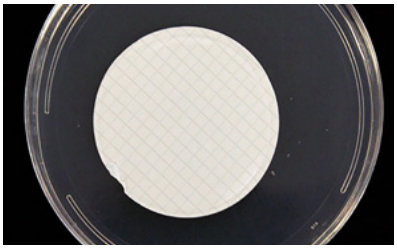
Maintaining clean waterlines is necessary to ensure that the water being used in a patient's mouth is at or below 500 CFU/mL, the safe level of drinking water, and free of harmful contaminants. Results should prove a bacterial reduction is present when a product is used correctly.

Example of Lab Testing Performed by DENTAL ADVISOR:

For this investigation, ***Monarch Lines Cleaner*** (Air Techniques), a chlorhexidine and ethanol-containing solution, was used to reduce and maintain bacterial levels in dental units with self-contained water bottles for a period of three months. While initial microbial levels varied between dental units, in the end, bacterial concentrations met or were below the 500 cfu/mL level recommended by the CDC. This level was observed as early as the first week of treatment. Dental personnel in the offices also reported that they and their patients had positive comments regarding the mint-flavored water during the investigation.



Culture of 1/10 dilution of water from unit #2 prior to treatment with *Monarch Lines Cleaner.*



Culture of undiluted water sample from unit #2 after treatment with *Monarch Lines Cleaner.*

ENVIRONMENTAL SURFACE WETNESS

What it Does:

Environmental surface wetness tests determine if a disinfectant wipe stays wet long enough to kill substances on contaminated clinical surfaces. It also can test the ability to clean and kill representative bacteria.

How This Applies Clinically:

It is important to know that the disinfectant you are using stays effective for the amount of time that is required to kill based on claims.

Example of Lab Testing Performed by DENTAL ADVISOR:

In this study, 9 disinfectant wipes were evaluated for their ability to maintain wetness when using a designated contact time. Four surface quadrants treated with ***Optim Blue*** (SciCan), ***Optim 33TB*** (SciCan), and ***OXY-1*** remained wet for the 1-minute contact time. In contrast, the other commercial disinfectants were unable to maintain surface wetness past two quadrant applications. The 2 high alcohol preparations (***FD 350***, Mikrozid AF) and dual phenolic (***Birex***) wipes dried faster than the contact time given on the label. In summary, the hydrogen peroxide disinfectant wipes performed the best under the conditions tested.

LONG-TERM EXPOSURE OF DISINFECTANT ON UPHOLSTERY

What it Does:

An electronic crockmeter repeatedly wipes upholstery samples with disinfectant and can be replicated to a specific period of time. Tensile strength is then measured on the material to determine if the material has degraded and become weaker, susceptible to tearing.

How This Applies Clinically:

Some disinfectants have been found to be so harsh that they discolor material and cause weakening of fibers, leading to tears and holes.

Example of Lab Testing Performed by DENTAL ADVISOR:

This study examined the effects caused by an accelerated 5-year interaction between ***Monarch Surface Disinfectant Wipes*** (Air Techniques) and ***Ultraleather*** and ***Dauphine*** dental chair upholstery. No visible changes in appearance were observed for either fabric treated with ***Monarch Surface Disinfectant Wipes***. In addition, there was no significant effect on the integrity of the ***Dauphine*** fabric after an extended exposure to test disinfectant solution. However, ***Monarch Surface Disinfectant Wipes*** did weaken ***Ultraleather*** test fabric, which can be seen with the significant decrease (14%) in tensile load. This suggests that the treated ***Ultraleather*** fabric may be more susceptible to tearing.

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Colgate Optic White Hydrogen Peroxide Toothpaste Laboratory Evaluation

M. Cowen, J.M. Powers

INTRODUCTION:

Staining or darkening the appearance of teeth can broadly be put into two categories which describes where the color change is occurring: Intrinsic and Extrinsic staining. Extrinsic staining occurs on the tooth enamel surface where pigments are trapped on the pellicle surface. This can be due to ingested substances, tobacco use and bacterial action and/or other substances. Intrinsic staining occurs when the internal enamel /dentin of the tooth is discolored either during tooth development, certain drug interactions, trauma and genetic factors. Internalization of discoloration can also occur when extrinsic colored pigments become internalized in areas of enamel defect and exposed dentin.

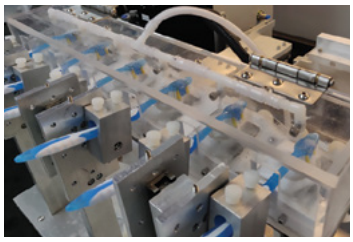
There are many whitening toothpastes available on the market and they come in two primary categories. Most have abrasives designed to primarily remove surface stains, while others have ingredients such as hydrogen peroxide (H_2O_2) that can penetrate the small porosities of the enamel and break apart the pigments that cause staining on the surface and inside enamel porosities. Hydrogen Peroxide is a popular bleaching agent as the relatively small molecule penetrates anywhere stains may reach, oxidizes the stains, which reduces the intensity of their color.

In this study, we evaluated the in vitro whitening effectiveness of ***Colgate® Optic White® Platinum*** toothpaste, containing 3% hydrogen peroxide, by using a spectrophotometer on stained bovine teeth brushed with our Toothbrushing Simulator. We compared its performance against ***Colgate® Cavity Protection*** toothpaste, which contains no hydrogen peroxide, to assess the difference in in vitro stain removal efficacy between mechanical action and the combination of chemical and mechanical action.

STUDY DESIGN:

Bovine Teeth were stained and randomly divided between groups with 12 replications each. Teeth were measured at baseline, at 6 brushing cycles and 14 brushing cycles with a ***Spectroshade Micro II Spectrophotometer*** (MHT Optic Research, Switzerland).

Teeth were brushed with a 1:1 ratio of artificial saliva and toothpaste with ***Colgate Optic White Platinum*** and ***Colgate Cavity Protection*** for 2 minutes at 120 rpm in a figure 8 pattern for 14 total cycles before being rinsed.



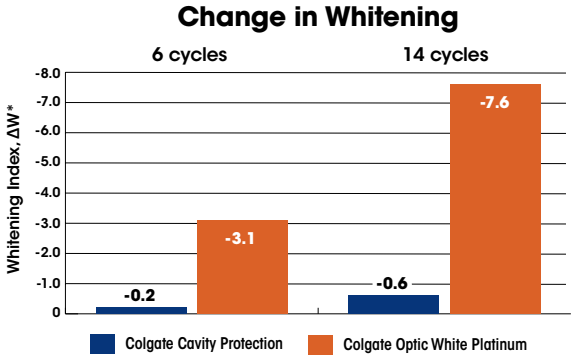
Whiteness Index

$$W^* = (a^{*2} + b^{*2} + (L^* - 100)^2)^{1/2}$$

$$\Delta W^* = W^*\text{ treated} - W^*\text{ baseline}$$

RESULTS:

Tooth color was measured by a spectrophotometer which gave L*a*b* color coordinates. A common measurement of whitening changes is calculated using a formula ΔW*. In this "Whiteness Index" a negative value change indicates whiter.



The toothpaste without hydrogen peroxide showed minimal change in color of the stained teeth, while ***Colgate Optic White Platinum*** showed superior in vitro whitening efficacy expressed as Delta W. This study shows that for fourteen two-minute brushing treatments which represents about a week of product usage, the toothpaste with hydrogen peroxide performed better than a toothpaste without. The decolorizing property of hydrogen peroxide has been shown to chemically alter stain molecules on the surface and within teeth leading to whiter results. This in vitro study validates the mode of action showing that incorporation of hydrogen peroxide in a toothpaste leads to superior stain removal and whitening results in comparison to a non-whitening fluoride dentifrice.

Research supported by Colgate-Palmolive Company

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Translating the Science

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Colgate Optic White Overnight Teeth Whitening Pen Laboratory Evaluation

M. Cowen, J.M. Powers

INTRODUCTION:

Among the many whitening products on the market, whitening gels which can be placed for longer periods can allow the active ingredient time to work. Higher percentages of whitening agents like hydrogen peroxide may work faster, but with the potentially greater risk of sensitivity if used improperly. Some whitening agents use greater than 30% hydrogen peroxide or over 40% carbamide peroxide which are only considered safe for in-office use.

In this study, we measured the whitening effect of ***Colgate® Optic White® Overnight Teeth Whitening Pen*** which is indicated for OTC use with 3% hydrogen peroxide overnight, or for several hours per use. We used stained bovine teeth which were treated, stored in a humid environment and color change measured with a spectrophotometer. We compared the whitening effect to a placebo pen without hydrogen peroxide to measure the total change in color by the whitening pen.

STUDY DESIGN:

Commercially sourced stained and mounted bovine teeth were split into 2 groups with 12 replications each. One group was treated with the Colgate Optic White Overnight Whitening Pen and one group was treated with a placebo product.

Tooth color was measured at baseline, after 3 treatments and after 7 treatments with a ***Spectroshade Micro II Spectrophotometer*** (MHT Optic Research, Switzerland) which provides L*a*b* color coordinates.

The L*, a*, and b* values were used to calculate the change in the whiteness index for each tooth after the 3rd and 7th treatment cycle when compared to the baseline reading. Whiteness is reported as ΔW*.

Whiteness Index

$$W^* = (a^{*2} + b^{*2} + (L^* - 100)^2)^{1/2}$$

$$\Delta W^* = W^* \text{ treated} - W^* \text{ baseline}$$

A more negative ΔW* indicates a closer resemblance of the tooth color to white.

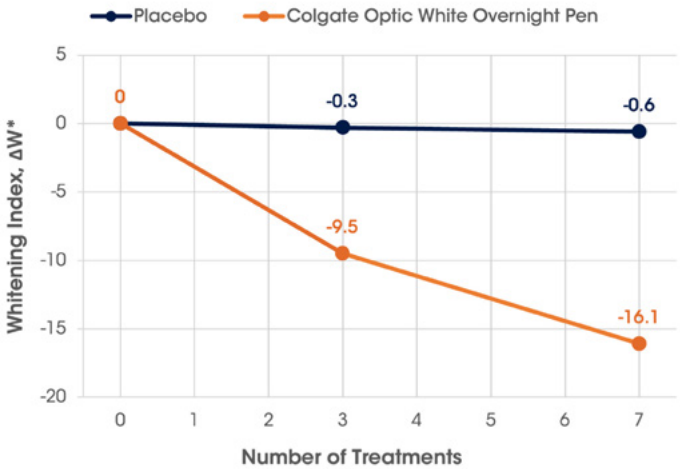
The teeth were treated similar to product usage instructions. The teeth are dried with a tissue prior to application. A thin layer of formula is applied onto each tooth's surface and then allowed to dry for several seconds. The treated teeth are placed in a sealed jar covered in wet towels to produce a humid environment overnight. The next day, the clear coating is removed. This process is repeated for 7 treatment cycles for the ***Colgate Optic White Overnight Whitening Pen*** and the placebo product.

RESULTS:

The results graph on the right shows the Whitening Index results, ΔW*, for the ***Colgate Optic White Overnight Whitening Pen*** and the placebo product after 3 and 7 overnight treatments. A more negative ΔW* indicates a closer resemblance of the tooth color to white.

The ***Colgate Optic White Overnight Whitening Pen*** produced a statistically significant whitening effect after only 3 treatments and continued through 7 treatments compared to the placebo product without hydrogen peroxide which showed minimal change in color on the stained bovine teeth and was not statistically significant.

Whitening Performance



CONCLUSION:

The results of this in vitro whitening study demonstrated that the ***Colgate Optic White Overnight Whitening*** pen exhibited significantly better whitening than the placebo formula after 3 and 7 overnight treatments.

Research supported by Colgate-Palmolive Company.

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New Single-Shade Composite Ecosite One

M. Cowen, J.M. Powers

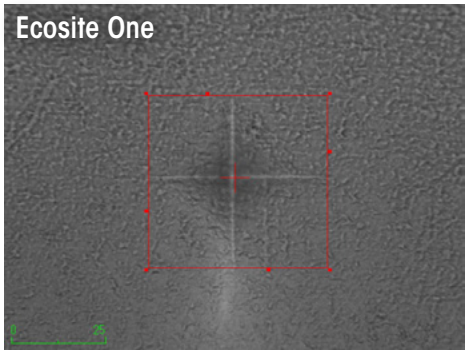
INTRODUCTION:

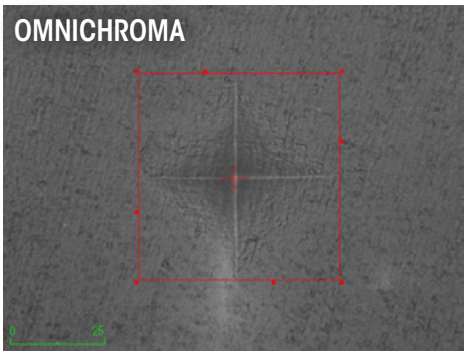
We recently tested a new single-shade composite ***Ecosite One*** from DMG America, which is primarily indicated for posterior cases in class I, II, V restorations and core build-ups. Among the claims DMG America makes is that the material can achieve over a 3 mm depth of cure in 10 seconds of curing time with a standard >1000 mW/cm^2 LED curing light for time savings, with excellent handling and polishing characteristics. In our testing, we measured the depth of cure claim, the polishability and the color stability after accelerated aging and staining.

Since the release of universal single-shade composite systems, simplifying shade selection for most cases has never been easier. Multiple studies have shown adequate color matching for the majority of shades. Single-shade composites benefit from additional surrounding dentition, as the chameleon effect relies on light reflecting through the material from the dentition in order to provide the chameleon effect. An added benefit of these single-shade composites is that a greater depth of cure can sometimes be achieved as the transluency of the composites are higher due to the need to allow light to pass through the composite to reflect off the surrounding dentition. Overall, single-shade composites can have a better color match in the long-term as their apparent shade can continue to change as the surrounding dentition changes color over time.

RESULTS SUMMARY:

- ***Ecosite One*** can be cured with 10-second exposures to over a 3-mm depth of cure.
- ***Ecosite One*** has an ideal hardness of 86 HV, which is about 37% higher than ***OMNICHROMA***, and may contribute to better strength and wear characteristics.
- The polishability of ***Ecosite One*** is excellent in terms of the speed of polishing and final result, with similar polishing characteristics to ***OMNICHROMA***.
- After intense simulated aging and staining, both ***Ecosite One*** and ***OMNICHROMA*** showed good color stability while ***Ecosite One*** had less change in translucency. ***Ecosite One*** in particular shows minimal change in color or translucency after aging in the 550-750 nm wavelength range responsible for yellow-red color, an important color range for apparent tooth shade. **This indicates a good ability to continue to match the color of the surrounding dentition over time.**





DEPTH OF CURE AND HARDNESS:

One 10-second exposure using a 1100 mW/cm^2 curing light produced approximately 4 mm depth of cure for *Ecosite One* and over a 5 mm depth of cure with a 20 second exposure. Keep in mind that this curing test is in a laboratory environment with perfect stability of the curing light centrally focused on the composite, so results achieved in a clinical environment might have a lower depth of cure. This should be a good safety margin as the IFU gives a 3 mm depth of cure after 10 seconds of curing with a >1000 mW/cm^2 LED curing light.

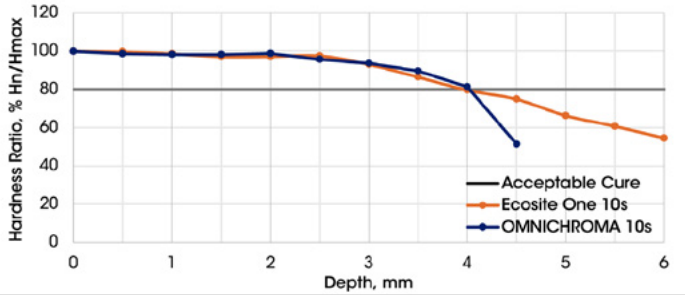
Hardness is a measurement determined by applying a certain load and measuring how much area of the material is deformed or how far the diamond indenter penetrates the surface. For composites, a hardness above 80 HV (Vickers hardness number), which is the approximate value of dentin, is suggested for composites to resist deformation and give better wear resistance.

Hardness measurements were made on composites cured for 40 seconds as well as the 10 and 20 seconds in the depth of cure test followed by 24 hours of curing at oral temperature. There were no significant differences between these curing periods. This means that curing for 10 seconds with a 1,100 mW/cm^2 LED curing light sufficiently cured the composites at the top.

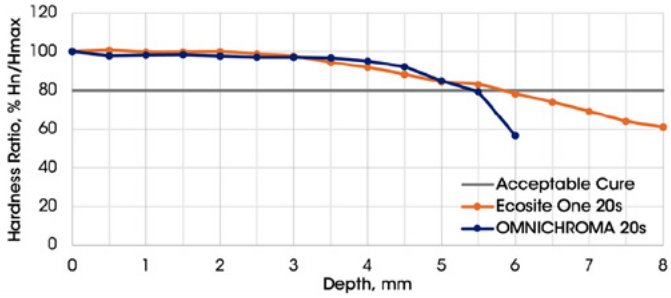
Ecosite One **has a higher overall hardness than *OMNICHROMA* (86 vs 64 HV), which may have benefits in wear properties and higher modulus. A higher hardness is a particular benefit for posterior composites to maintain shape under occlusal forces and reduce wear over time.**

Hardness is also a useful measurement of the quality of cure for a composite, as it is closely correlated with the quality of the polymerization of a given composite. The point in which the hardness drops to 80% of the maximum hardness is commonly suggested as the minimum clinically acceptable curing level. These graphs depict the hardness ratio which is an indirect way of measuring the polymerization %; as the hardness drops, the polymerization % drops. Overall, ***Ecosite One*** and ***OMNICHROMA*** have similar curing profiles over the critical depth of cure region. Keep in mind that these are hardness ratios, and the starting hardness of ***Ecosite One*** at the 100% ratio is 86 vs 64 HV for ***OMNICHROMA***.

Depth of Cure by Hardness Ratio
10-second cure @ 1100 mW/cm²



Depth of Cure by Hardness Ratio
20-second cure @ 1100 mW/cm²

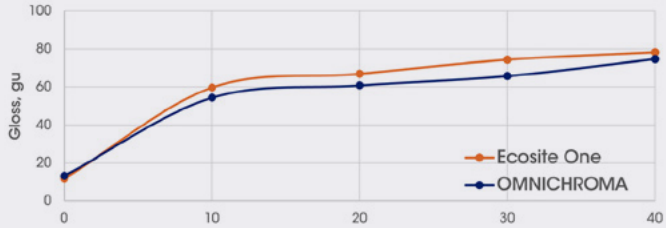


POLISHABILITY:

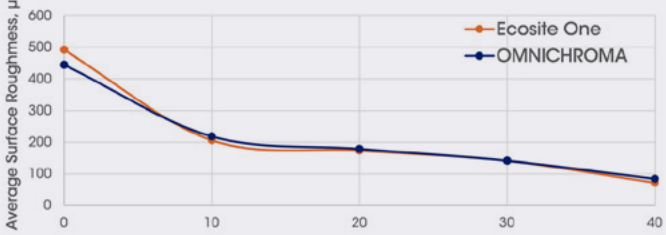
Polishing composites is an important step for not just esthetics, but also to reduce the ability of microbes to adhere to the surface. Bacterial adhesion and staining potential have been shown to attach to surfaces more when surface roughness is higher, so achieving a smooth surface after the adjustment of composite surfaces is paramount. A general threshold for an acceptable polish to minimize bacterial adhesion and acceptable gloss is about 60 gloss units (gu) and 200 nm (0.2 microns) surface roughness. Average surface roughness is the measurement of the variability of the surface texture, where a higher value indicates a rougher surface, and a lower value indicates a smoother surface.

Our polishing test starts with a rough composite surface prepared with 320-grit paper to simulate adjustment with a medium bur. The polishing test was conducted with the ***3M™ Sof-Lex™ Diamond Polishing System***, which is a two-step polishing system. The surface is finished for 10 seconds with the pre-polishers which create a starting average roughness of about 500 nm and gloss of 10 gu for each composite. This was followed with 10, 20, 30, and 40 seconds of polishing with water with the 2nd step polisher, with three gloss and surface measurements taken on three independent samples for each step.

Gloss



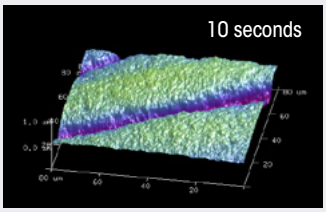
Surface Roughness

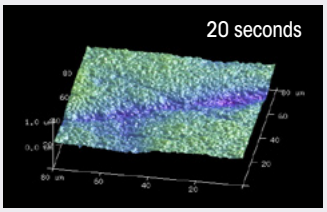


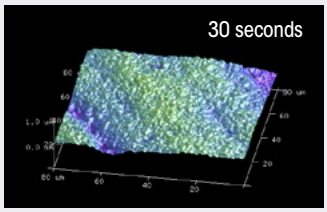
Ecosite One **has a higher gloss value at a similar relative surface roughness indicating that it is inherently glossier. In terms of polishing efficiency,** ***Ecosite One*** **shows a good balance of hardness to resist wear while exhibiting high polishability.** This is important as some composites with a high hardness take longer to polish, especially those with larger filler particle sizes. Both materials can reach the goal of roughly 200 nm of surface roughness after 10 seconds of polishing.

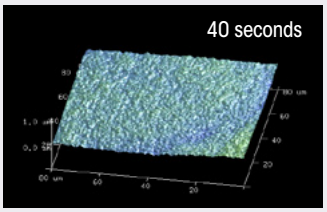
AFM scans show the surface topography on a small section of the polished specimens. The surface roughness of these small areas may better correlate with light reflectance, or glossiness, but are subject to small area sampling bias.

Ecosite One

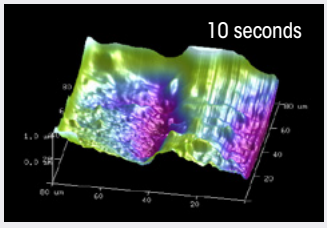


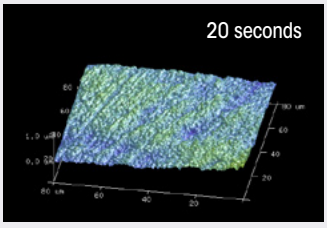


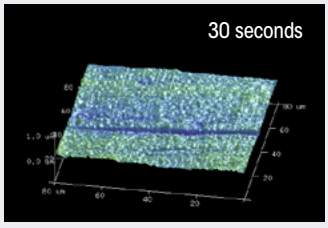


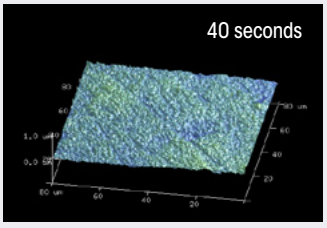


OMNICHROMA





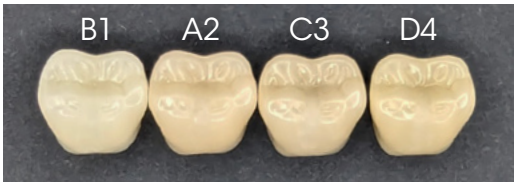




COLOR STABILITY:

The long-term color stability and stain resistance of composites is an extremely important factor for patient acceptance of composite restorations. The science of how the new category of one-shade composites match color over time is a subject of active investigation. One of the primary attributes that allows the one-shade composites to blend with the surrounding dentition is the increased translucency compared to conventional composites. This increased translucency or ability for light to pass through the composite allows light to reflect off the surrounding dentition and appear to make the composite match the shade of the teeth.

Example of Ecosite One with slot prep in various shades of denture teeth



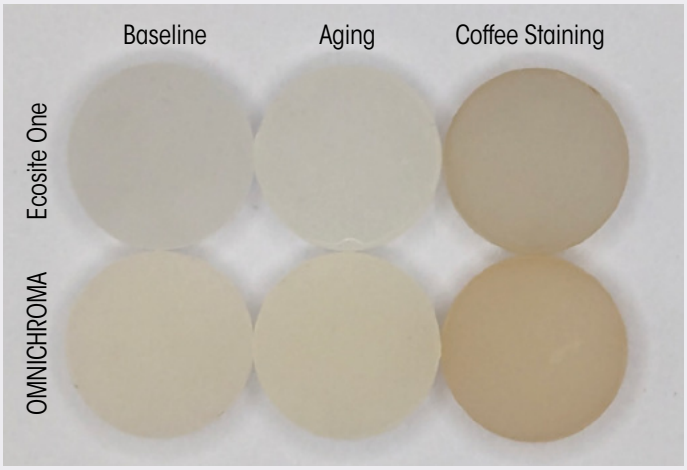
Ecosite One has a much more neutral starting shade with a similar translucency level as ***OMNICHROMA***. In shade matching tests with ***Ecosite One***, the chameleon effect is apparent at placement and appears to match most shades well, unlike ***OMNICHROMA*** in which the chameleon effect is not apparent until after light-curing.

OMNICHROMA has no pigments contained in the composite, but has spherical particles that generate a reddish yellow color from the structure of the filler particles. Color is mixed with the light reflected off the surrounding dentition in an additive process to produce the final perceived appearance.

Color Stability and staining tests were conducted at the John M. Powers, PhD Houston Center for Biomaterials and Biomimetics at the UTHealth Houston School of Dentistry using ISO 4892 standard procedures to simulate several years of aging and staining in coffee. The accelerated aging test is a cyclic test with changes in humidity, water exposure, intense light and temperature. The coffee staining test involved 7 full days of immersion in coffee, which is the worst-case scenario for staining compared to real use scenarios in which the coffee will be diluted by saliva and surface stains cleaned by toothbrushing. The specimens were then compared to baseline readings to determine the change in color and translucency.

RESULTS:

Ecosite One **had a slightly lower change in translucency than** ***OMNICHROMA*** **after aging and staining which might indicate less impact on the chameleon effect over time.** An image of the specimens side by side shows the color change for the different groups. **The overall change in color after accelerated aging was similarly low for both composites.** ***Ecosite One,*** which starts from a more neutral (lower b* meaning less yellow) value, ends with a lower b* than ***OMNICHROMA*** after coffee staining.

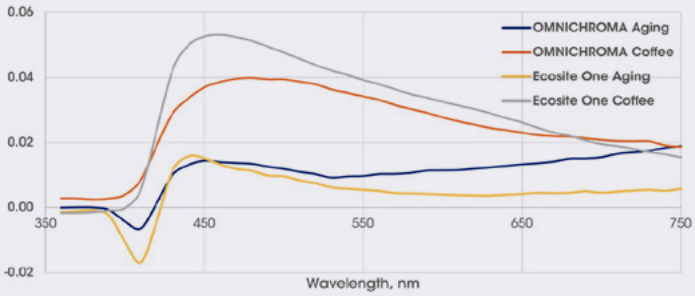


Ecosite One **shows less apparent color change on the reflectance curves after aging, particularly in the 550-750 nm range.**

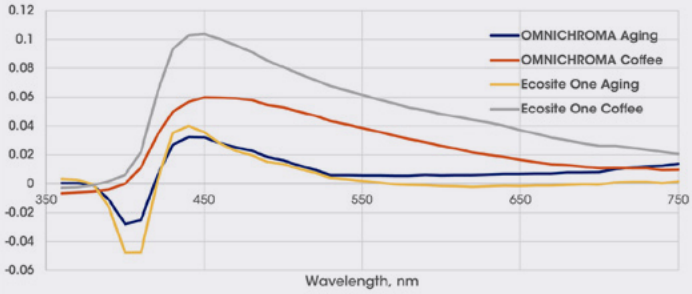
The curves below are useful for showing the relative differences between materials. The curves on the left are the difference in the change in translucency (white minus black backgrounds), and color appearance (white background) after aging and staining. A value near 0 indicates no change, a value below zero indicates an increase in color or transmission at that wavelength, a value above 0 indicates a decrease in color or translucency at that wavelength.

The reflectance curves may not directly correlate with Translucency Parameter (TP) or ΔE^*_{00} values as the L* a* b* values are not weighted equally across the color space as it is specialized to human color perception. The average TP changes for ***Ecosite One*** were 0.4 after aging and 0.9 after staining compared to 0.8 and 1.1 for ***OMNICHROMA***, which are below the threshold for human perceptibility of translucency change.

Reflectance Curve Translucency Change



Reflectance Curve Color Change



Research supported by DMG America.

Grind Relief Pro

Grind Guard Technologies, LLC www.grindreliefpro.com

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DENTAL ADVISOR ++++

30 CLINICAL EVALUATORS

98 TOTAL USES

86% CLINICAL RATING

Key features: Small device • No lab required • Same day therapy

Description

Grind Relief Pro is a thermoplastic medical device intended to treat nighttime or stress-induced bruxism and reduce muscle activity by at least 60%. Built with a patented "Central Power Bar", this additionally helps by preventing wear through the appliance.

Indications

- Bruxism patients
- Great for immediate assessment of TMD and Muscle Myalgia when screening for muscle or joint pain

Unique Attributes

- Covers more of the dentition for a more secure fit (back to the 1st or 2nd bicuspid)
- Can be used on either the maxillary or the mandibular arch
- Adjustable with an ability to refit the appliance if the fit loosens or changes
- Can be used with a Class 2 occlusion

Photos courtesy of Dr. Frank Berman

Clinical Tips

- The thermoplastic material gets very sticky after heating, don't touch it.
- Once the device is fabricated and the patient is wearing it regularly, have the patient warm it under warm water before putting it in.
- Train the patients on how to adjust the device by including them on the initial fitting. We found that many small adjustments can be done at home without having to return to the office.
- Leave it in for 10 minutes after fitting for improved retention.

"QUICK AND EASY TO FIT."

Evaluators' Comments

"I am able to provide the patient with an immediate device to take home to see if they get TMD and muscle myalgia relief."

"Same day, no models!"

"Easy to use in a pinch and can use Peter Dawson's NTI/ deprogrammer methods fast."

"The rigid shell allows it to adapt better than the somewhat softer shell in the OTC doctor's nightguard."

"The fit is better and the end product is more durable than QuickSplint"

"It is easy to fabricate chair side. It has great retention once fully hardened, and it works very well in a dentition with severe crowding. One patient said it was the most comfortable guard she has ever worn."

"Nice device for acute treatment. The innovation is the rigid frame allowing for improved adaptation to undercuts and improved retention."

Consultants who would:

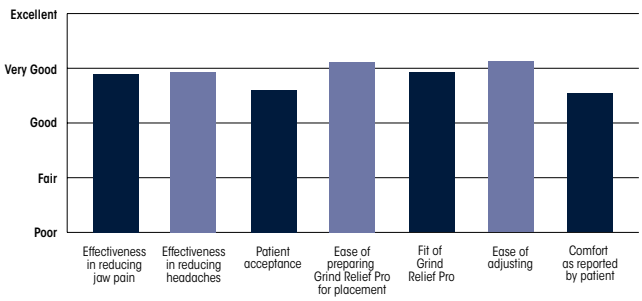
83% Recommend to a colleague

Consultants who would want to stock in office:

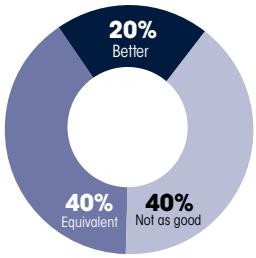
7% Yes, instead of current product

63% Yes, in addition to current product

Evaluation Summary:



Compared to Competitive Products:



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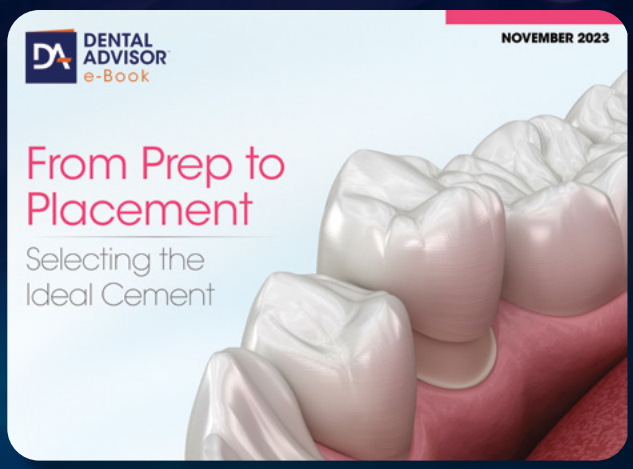

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Motion Graphic Video

Motion Graphic Video

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Clinical Video

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