

Technical Profile

Rev. 04 - Jan/10

**MORE TECHNOLOGY
NANOPARTICLES**



Composite for Anterior
and Posterior Teeth

Opallis+

You're Worth It.



INDEX

1. Presentation	01
2. Basic Composition	01
3. Main Features	01
4. Product Presentation	02
5. Physicalchemical and Mechanical Properties	03
5.1 Color Stability	03
5.2 Brightness	03
5.3 Rheological Stability	04
5.4 Degree of Conversion	05
5.5 Flexural Fatigue Limits	06
5.6 Wear	07
5.6.1 Surface Roughness After Simulated Brushing	07
5.6.2 Wear and Roughness After Simulated Mastication Test	07
5.7 Distribution of Particle Size	09
5.8 Compressive Strength	09
5.9 Diametral Compressive Strength	09
5.10 Knoop Hardness	10
5.11 Elastic Modulus	10
5.12 Flexural Strength	11
5.13 Polimerization Shrinkage	11
5.14 Dentin Bond Strength	12
5.15 Sensitivity to Light	12
5.16 Translucence Level	13
5.17 Toxicity Tests	14
6. Opallis Color System	14
6.1 Effect Colors	15
6.1.1 Translucent	15
6.1.2 Value	15
6.1.3 Extra-Opaque Colors	15
6.1.4 Bleach Colors	15
7. Concluded Research Projects	16
Research 1: Study of Fluorescence of Composite Resins	16
Research 2: Visual Perception of the Color Difference Between Several Composite Resins and the Vita Classical Shade Guide	18
Research 3: Laboratorial Evaluation of Bond Strength of Two Restorative Composite Resins for Dentin, Mediated by Different Adhesive Systems	19
Research 4: Year Evaluation of the Clinical Performance of Opallis Composite Resin: Class II and V Restorations	21
Research 5: Comparative Evaluation of Physical-Mechanical Properties of Different Composite Resins	24
Research 6: Evaluation of Abrasive Wear Resistance of Universal Composite Resins	25
Research 7: Color perception of composite resins regarding Vita Shade Guide	25
Research 8: Influence of finishing time on marginal sealing of direct restorations	26
8. Instructions	26
8.1 Color Selection	27
8.1.1 Methods for the Choice of Color	27
8.2 Product Application	27
8.3 Precautions and Contraindications	27
8.4 Side Effects	28
8.5 Storage and Maintenance	28
8.6 Warnings	28
9. References	28

1. Presentation

Opallis+ is a microhybrid composite resin for anterior and posterior teeth. The composite is available in four translucence levels – enamel, effect enamel (extra-opaque and translucent), dentin and value – distributed in thirty five shades following Vita Classical Shade Guide (for enamel and dentin). Opallis+ also offers special shades for bleached teeth. Indispensable esthetic features such as fluorescence, opalescence and superior polishing capability are also offered by Opallis+. These optical qualities associated to a high mechanical performance allow the achievement of excellent restorations.

The new Opallis + Technology was developed in order to improve extremely important clinical characteristics. In this new presentation, polishing and brightness are taken to a superior level. The consistency (rheology) of the composite was also renewed and it is now softer, of easy handling and excellent carving capability.

Brightness and polishing properties were improved by judicious adjust of Opallis load particles distribution. This adjustment allows better results in esthetic restorations, with significantly higher brightness levels.

The implementation of an innovative and efficient silanization process of Opallis+ load particles brought as a benefit better dispersal and higher interaction between load and monomers, leading to a softer consistency and higher rheological stability, without losing handling and carving characteristics.

All of this technology attested by an elevated quality control, in which sophisticated equipment takes part, such as rheometers, thermal analyzers, spectrophotometers, microdurometers and others. We ´ve created a product to help you offer the best to your patients: Opallis+ .

2. Basic Composition

Active ingredients: Bis-GMA monomers (Bis-phenol A di-Glycidyl Methacrylate), Bis-EMA (Bis-phenol A di-Glycidyl Methacrylate ethoxylated), TEGDMA (Triethylene glycol dimethacrylate), UDMA (Urethane dimethacrylate), canforquinone, co-initiator and silane. Inactive ingredients: Silanized barium-aluminum silicate glass, pigments and silica.

Opallis + presents load particles in the range of 40nm to 3.0 microns for dentin shades and 40nm to 2.0 microns for enamel and effect enamel shades. The medium particle size is of 0,5 microns, total load weight of 78,5% to 79,8% and inorganic load volume of 57% to 58%. The distribution of the sizes of the particles allows the appropriate filling of the resin contributing to its high level of mechanical and wear resistance, which is a necessary feature for restorations in posterior teeth while the reduced medium size of the particles makes them easy to polish enabling a restoration with flat surface and high shine.

3. Main Features

- High level of brightness and polishing on enamel and effect enamel.
- Variety of colors which allow successful completion of simple and intricate clinical cases.
- The enamel and dentin colors follow the Vita Classic shade guide.
- Easy color identification through the letters E (enamel), D (dentin), T (translucent), and O (extra-opaque).
- Specific colors for bleached teeth (E-Bleach L, E-Bleach H, E-Bleach M, D-Bleach).
- Colors with high translucence level for aesthetic restorations (T-Yellow, T-Blue, T-Orange, T-Neutral, VH, VM, VL).
- Its mechanical properties follow the requirements for restorations in anterior and posterior teeth.

- Excellent radiopacity.
- Opalescence identical to the one of the natural teeth.
- Fluorescence balanced with the one of the tooth structure.
- Elevated conversion degree.
- Reduced wear and surface roughness contributing for shine maintenance and restoration longevity.
- Ergonomic packing with the cap fitted to the syringe body.
- Special colors are marketed in a smaller amount (2g), following consumption frequency.

4. Product Presentation

Clinical Kit - 15 syringes

Ea1, EA2, EA3, EB2, DA1, DA2, DA3, DB2, D-Bleach, T-Blue, T-Neutral, T-Yellow, E-Bleach H, Opaque Pearl and VH.

Kit 12 Colors - 12 syringes

EA1, EA2, EA3, EB2, E-Bleach M, DA1, DA2, DA3, DB2, OW, T-Yellow e T-Neutral

Kit Básico - 6 seringas

EA2, EA3, EA3.5, DA2, DA3 e T-Neutral

Refill

1 syringe with 4g for colors of more frequent use and 2g for special colors, as described in the chart below:

Category	Colors	Polymerization time*	Quantity	Translucence (%)
Dentin	DA1	40 s	4 g	43,0 - 46,0
	DA2	40 s	4 g	
	DA3	40 s	4 g	
	DA3,5	40 s	4 g	
	DA4	40 s	2 g	
	DB1	40 s	4 g	
	DB2	40 s	4 g	
	DB3	40 s	2 g	
	DC2	40 s	2 g	
	DC3	40 s	2 g	
	D-Bleach	40 s	2 g	
Enamel	EA1	20 s	4 g	53,0 - 56,0
	EA2	20 s	4 g	
	EA3	20 s	4 g	
	EA3,5	20 s	4 g	
	EA4	40 s	2 g	
	EB1	20 s	4 g	
	EB2	20 s	4 g	
	EB3	40 s	2 g	
	EC2	40 s	2 g	
	EC3	40 s	2 g	
	E-Bleach H	20 s	2 g	
	E-Bleach M	20 s	2 g	
	E-Bleach L	20 s	2 g	
Effect enamel	Translucent colors			
	T-Blue	20 s	2 g	78,5
	T-Yellow	20 s	2 g	78,5
	T-Orange	20 s	2 g	78,5
	T-Neutral	20 s	2 g	66,0
	Extra-Opaque colors			
	Opaque Pearl (OP)	60 s	2 g	35,0
	Opaque White (OW)	60 s	2 g	35,0
	B0,5	60 s	2 g	35,0
A0,5	60 s	2 g	35,0	
Value	VH (high)	20 s	2 g	70,0
	VM (medium)	20 s	2 g	
	VL (low)	20 s	2 g	

*recommended density power: 400 mW/cm².

5. Physicalchemical and Mechanical Properties

5.1 Color Stability

For a restoration to have clinical success, it is essential that the restorative technique applied is adequate, respecting all of the precepts of use of a composite resin. However, the material itself plays a big role on obtaining success on the process, and we can consider resin discoloration as being one of the biggest factors that leads to restoration replacement. Thus, it is indispensable for the composite to present color stability, which is a characteristic that can even be evaluated in vitro using specific equipment.

On the following experiment, composite resin specimens were prepared following the polymerization time recommended by the manufacturers. The specimens were stored in deionized water for 24h to perform immediate color check using a X-Rite SP62 spectrophotometer, on CIE L*a*b scale. After four weeks, the checking was done again and the results tabulated and statistically evaluated.

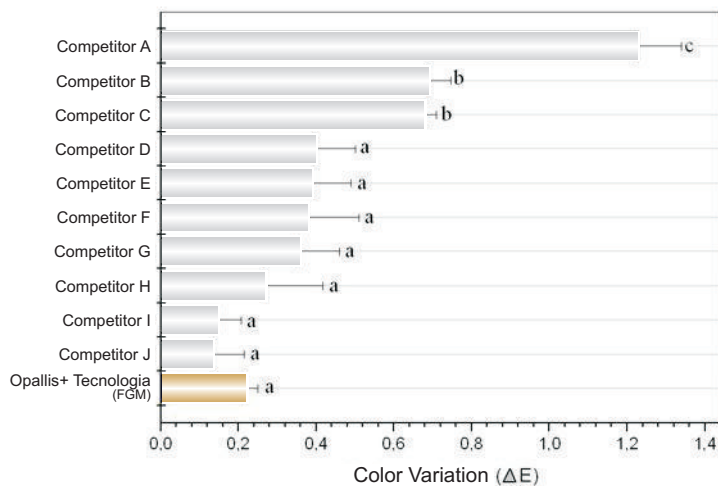


Figure 1: Color variation of composites aged in deionized water (37° C) for four weeks.

Source: FGM Produtos Odontológicos Ltda. (Different letters indicate statistical difference ($p < 0,05$)).

The results show that the major part of the composites tested, including Opallis+, maintained its initial color. It was observed statistical difference between composites Competitors A, B and C.

5.2 Brightness

The brightness of a surface is an optical property based on light interaction with the material's surface. The brightness we observe is associated with the capability of surfaces to reflect the incident light on specular direction. The higher the radiation reflected on the same direction, the higher the brightness we observe. Many factors may influence brightness such as, in example, the material's refractive index, the incident angle of the light and the surface topography, in other words, the smoothness of the surface.

We know that the smoothness of a composite resin surface is fundamental to perfectly substitute the tooth structure lost. For that reason, we intensely investigated the relationship between load particle size of composite resins and its effect on polishing and consequently final brightness. Through this research we came to an excellent result for Opallis+, as seen next.

On the following test presented, specimens made of enamel resin composite were prepared in a specific mold, followed by photopolymerization according to each manufacturer. After 24h, the specimens were submitted to polishing as recommended by ASTM D-523 standard, using 600 grit sandpaper. This procedure allows observation of the intrinsic capability of each composite to achieve brightness. Certainly, the use of polishing materials of fine granulation (such as FGM Diamond Excel polishing paste) would give the composites a higher level of shine, regardless of the load particle distribution of the resin. Because of this, in this test was aimed to challenge each composite without the contribution of polishing materials.

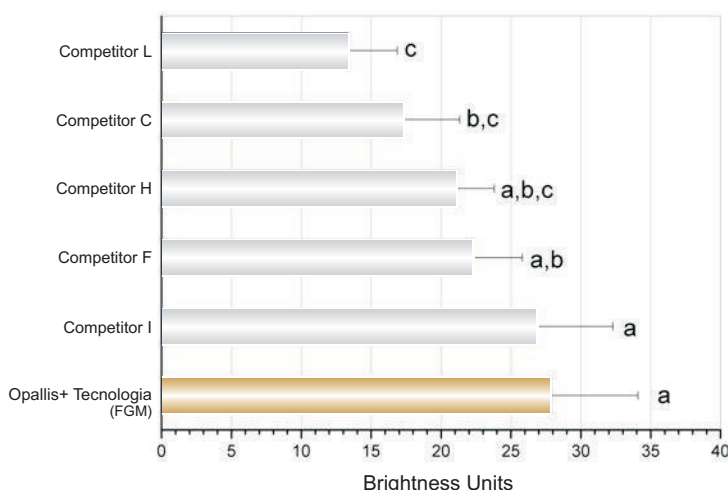


Figure 2: Level of brightness achieved by different composite resins submitted to polishing only with 600 grit sandpaper, as ASTM D-523 standard.

Source: FGM Produtos Odontológicos Ltda. (Different letters indicate statistical difference ($p < 0,05$)).

The results above show that Opallis+ and Competitor I has the higher medium value of brightness, statistically similar to Competitors H and F. Presenting a high value of brightness/smoothness without the need of polishing with felt disks and pastes shows a favorable condition mainly on proximal restorations, where there is no access to perform an adequate polishing. When this surface is smoother only by the application of sandpaper strips, clinical conditions and longevity of the restoration are improved.

5.3 Rheological Stability

The consistency of a composite is fundamental to its adequate manipulation on oral cavity. Due to the clinical importance of this characteristic we search for a perfect balance between the responsible substances in Opallis+, paying attention especially to the product's stability of consistency over time. Also, another considered factor was the capability of easy manipulation of the material, without adhering to the spatula improperly or presenting itself sticky.

To reach this level of knowledge and guarantee the same consistency of the composite in every new batch, specific methods has been developed to quantify the consistency. The current rheometer that makes the checking is even more sensitive than experienced professionals.

The graphic bellow shows the pattern and reproducibility of consistency from different batches of Opallis+ shade EA2 and EA3, evaluated by a TA-2000 rheometer (TA Instruments).

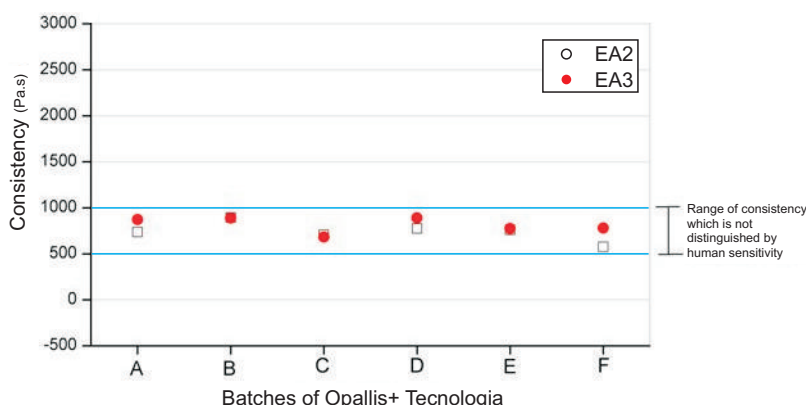


Figure 3: Consistency of different batches of Opallis indicating it's adequate reproducibility. The blue region means a range of consistency which even experienced professional cannot distinguish.

Source: FGM Produtos Odontológicos Ltda.



Therefore, our exigent quality control brings the same viscosity/consistency to each composite, in every new batch. This characteristic is synonymous of more confidence on the product by the professional.

Figure 4: Excellent consistency: easy carving.

5.4 Degree of Conversion

The degree of conversion reflects the quantity of monomers that converts to polymers after the polymerization process. A high degree of conversion contributes to increase mechanical properties of a composite, reduction of water absorbance and also provides higher shade stability of final restoration.

The residual monomers – those which were not converted to polymers – are responsible for many problems, such as decrease of mechanical properties and toxic effects to pulp cells.

Many factors may interfere on the quality of polymerization and, consequently, on the degree of conversion. For example; the reduction of power density of the light curing unit over time, reduced light curing time and chemical characteristics of the resin monomers.

Therefore, the degree of conversion could impact on the clinical performance, altering physical, chemical, biological and esthetical properties of composite resins and thus, consists of an important data to the composite.

Figure 5 shows the result of a test made in University of Erlangen (Germany), where three composite resins (Opallis - FGM, Tetric EvoCeram - Ivoclar Vivadent and Filtek Supreme XT - 3M ESPE) were submitted to a test in order to reveal its degree of conversion. Disc-shaped specimens (6mm in diameter and 2.5 in thickness) were made from each composite and the light curing process was made using equipment with power density of 800mW/cm² respecting light curing times as recommended by each manufacturer. The specimens were analyzed on top (face with closest contact to light curing unit tip) and on base.

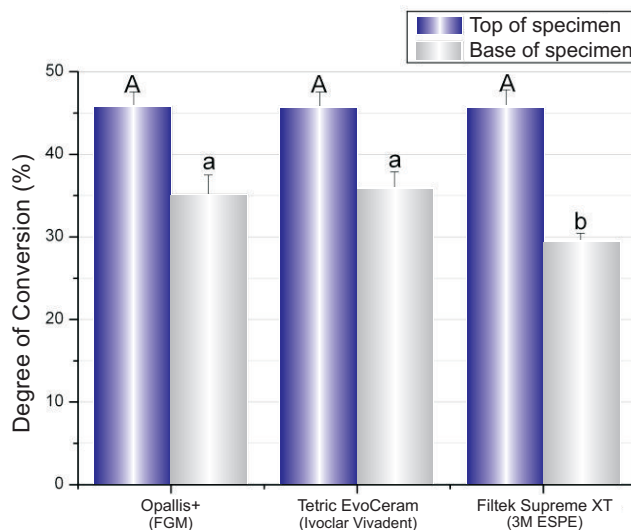


Figure 5: Degree of conversion of different composite resins on top and base of specimens.

Source: Dr. Ulrich Lohbauer et al. – University of Erlangen – Germany (Different letters indicate statistical difference (p<0,05)).

From the results, it could be observed that the top (superior face of specimens) had higher degree of conversion than the base, and that Opallis shows results statistically similar to its competitors.

5.5 Flexural Fatigue Limits

For evaluation of flexural fatigue limits of Opallis, it was used the 4-point bending test. Specimens were made according to ISO 4049 standard and submitted initially to 50% of the load supported on the 4-point bending test. According to specimen's behavior under cycling (after 10.000 cycles), the level of stress for the second sample stood in constant increments, following the staircase method.

On the next graphic, results of 4-point bending test, initial and after fatigue, are presented. Testing materials after fatigue is of great importance since it's similar to what occurs with the masticatory function.

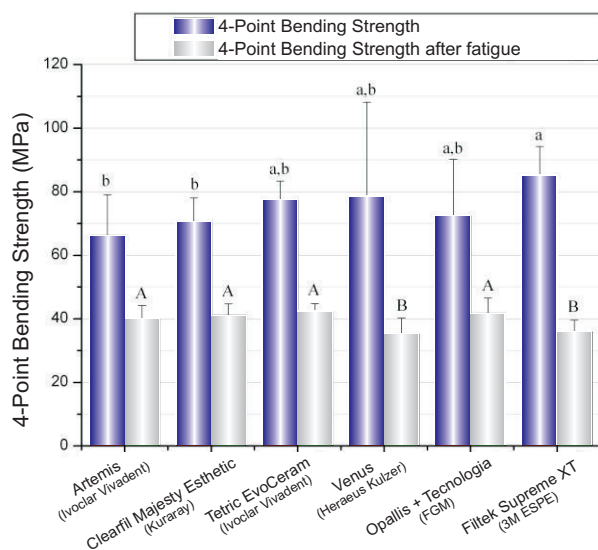


Figure 6: Flexural resistance to 4-point bending test: initial and after fatigue.

Source: Dr. Ulrich Lohbauer et al. – University of Erlangen – Germany (Different letters indicate statistical difference ($p < 0,05$)).

A result that provides clear analysis of the mechanical behavior of the composite is presented next, and shows the percentage of decrease on flexural strength before and after cycling the specimens.

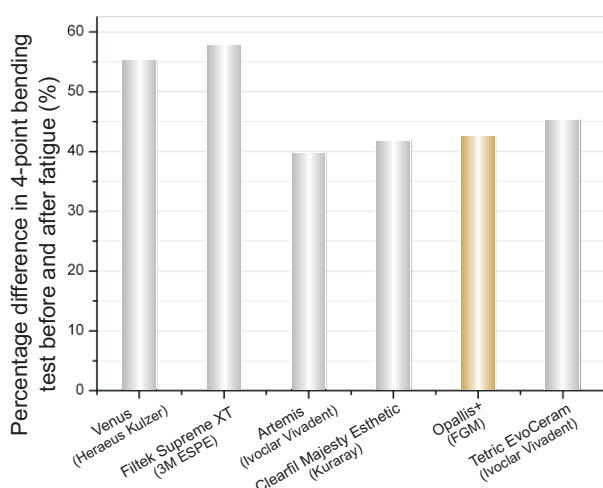


Figure 7: Percentage difference in 4-point bending test before and after fatigue.

Source: Dr. Ulrich Lohbauer et al. – University of Erlangen – Germany

Results shows that Opallis presented lower percentage decrease of flexural resistance than resins like Filtek Supreme XT (3M ESPE) and Venus (Heraeus Kulzer), indicating higher flexural strength after cycling.

5.6 Wear

Composite resin wear involves different processes found in the oral cavity, these are of different origins such as abrasion, attrition, and erosion (Mondelli, 1995). Abrasion is one of the wear factors, corresponding to a process in which the material is progressively removed from the surface of a solid body by action of an abrasive material. As such, the resins may suffer wear from the brushing action, dental contacts, and attrition from mastication of abrasive elements (Martinez, 2004). The wear of Opallis composite resin and of several commercial brands was evaluated through simulated brushing and simulated mastication in the three-body wear test.

5.6.1 Surface Roughness After Simulated Brushing

In this test, the composite resin (first body) suffers abrasion from the toothpaste (second body) and a toothbrush with soft bristles (third body) during 100.000 brushing cycles. The surface roughness of the composite resin was determined before and after the brushing cycles with a surface roughness machine. The roughness difference before and after the wear test is presented in Figure 8. The results of roughness difference presented in Illustration 1 indicate that Opallis (FGM) has a similar wear level to Esthet X (Dentsply) and Filtek Supreme (3M) resins. The other composite resin brands presented larger roughness difference in comparison to this group. The result obtained by Opallis is mainly due to the adjustment of the size of the particles which compose the resin, and to the strong chemical bond between the polymer and the load, impeding the detachment of the particles from the resin surface.

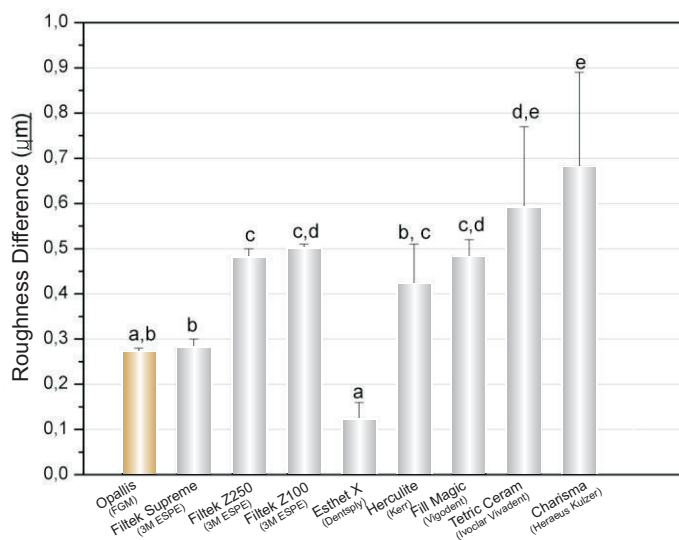


Figure 8: Roughness difference between Opallis composite resin and other commercial brands after in vitro wear test.

Courtesy of: Dr. Baratieri et al. (2005) of Federal University of Santa Catarina (UFSC).

5.6.2 Wear and Roughness After Simulated Mastication Test

The objective of this study was to evaluate wear and surface roughness of several composite resins after a simulated mastication test. In this test, the resin specimens were previously polished and submitted to 400.000 mastication cycles in a mechanical cycling machine from the School of Dentistry of the University of São Paulo. Slices of bovine enamel were used in the simulated mastication tests. After the mechanical cycling, specimens were analyzed in a surface roughness machine (Mitutoyo SurfTest 211) and the suffered wear was analyzed in comparison to the M-L scale (Lugassy and Moffa, 1985). Illustrations 2 and 3 show the roughness and wear results (Rz and Ra) before and after the specimens were submitted to the simulated mastication test.

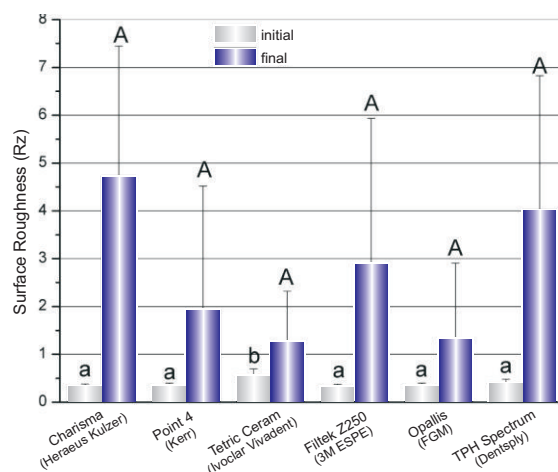


Figure 9a-b: Maximum surface roughness (Rz) and medium surface roughness (Ra) of composite resins submitted to 400.000 mastication cycles. Opallis presented an excellent result compared to the study group.

Courtesy of Dr. Carlos Francci et al. (2005) of the School of Dentistry - University of São Paulo.

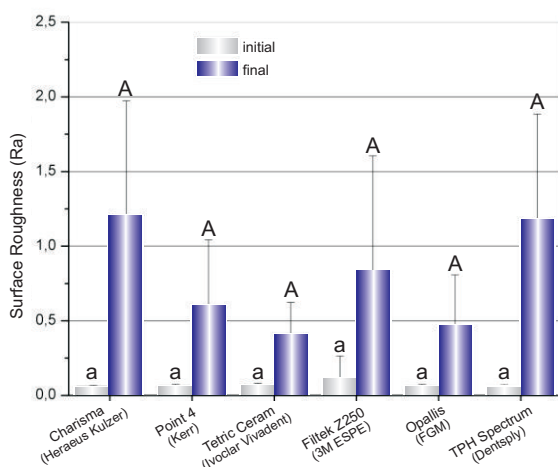


Figure 9b.

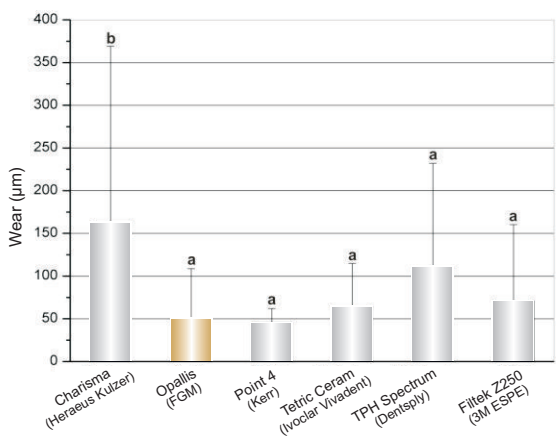


Figure 10: Wear suffered by composite resins submitted to 400.000 mastication cycles. Opallis resin presented an excellent result compared to the study group.

Courtesy of Dr. Carlos Francci et al. (2005) of the School of Dentistry - University of São Paulo.

The excellent result obtained by Opallis resin in the wear by simulated mastication tests is mainly due to the distribution of the size of the particles, the medium size of the particles which compose the resin and the silanization treatment of the surface of the loads. The silanization process developed by FGM allows a strong anchorage of the load particles in the monomeric matrix, resulting in a composite with reduced wear and high mechanical properties. The atomic force microscopy images (AFM) below were obtained from the surface of the Opallis resin after polishing (left) and after wear by simulated mastication (center). It is observed that the resin allows excellent polishing and generates a flat surface. After the wear test by simulated mastication, the resin surface became irregular. However, cavities or depressions from the loss of big particles were not observed.

5.7 Distribution of Particle Size

The medium size of the particles of several resins was determined through low angle laser light scanning (LALLS) in a Malvern device, model Mastersizer S long bed. The resin samples were dispersed in acetone to separate the loads from the monomeric part, thus generating suspension which was used in the analysis.

Figure 11 shows that Opallis presents reduced medium size particles, justifying its excellent performance in the wear tests.

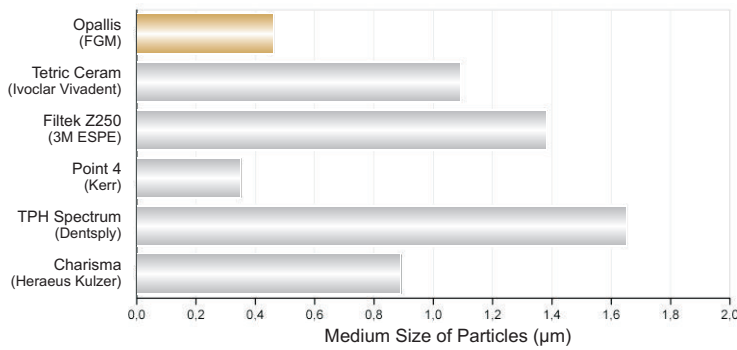


Figure 11: Medium size of particles of several resins.

Courtesy of Dr. Carlos Franci et al. (2005) of the School of Dentistry - University of São Paulo.

5.8 Compressive Strength

The resistance to compression is one of the most important parameters in the physical evaluation of a resin due to its correlation with mastication forces. Opallis was submitted to compressive strength test in comparison with other commercial resins. The tests were developed according to the experimental procedure described by Craig and Power (2004) and Phillips and Anusavice (1998). Figure 12 represents the compressive strength of several composite resins. Opallis presented statistically similar behavior to the resin Charisma and significantly superior behavior to the brands Tetric Ceram, Filtek Supreme and Esthet X.

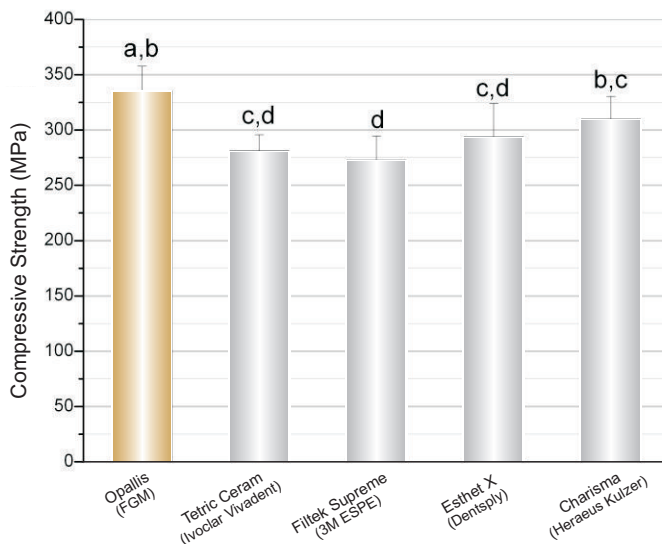


Figure 12: Compressive strength.

Courtesy of Dr. Luiz Narciso Baratieri et al. (2005) of the Federal University of Santa Catarina.

5.9 Diametral Compressive Strength

The diametral compressive strength is accomplished in a similar way to the compressive strength test. However, the force is applied on the side of specimen until the moment of fracture. Figure 13 shows the results of diametral compressive strength of several commercial brands. The tests were developed according to experimental procedures described by Craig and Power (2004) and

Phillips and Anusavice (1998). It is verified that Opallis presents statistically superior values to the resins Tetric Ceram, Filtek Supreme and Charisma.

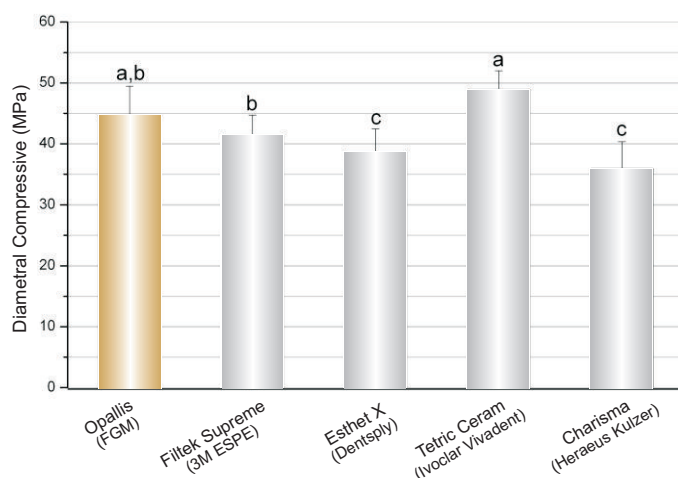


Figura 13: Diametral compressive strength.

Courtesy of Dr. Luiz Narciso Baratieri et al. (2005) of the Federal University of Santa Catarina.

5.10 Knoop Hardness

Figure 14 presents Knoop hardness values of Opallis (FGM) and of other commercial resins according to the experimental method described by Barros et al. (2004). Opallis did not present statistical difference in comparison to Tetric Ceram and Esthet X resins, and it was superior to Charisma.

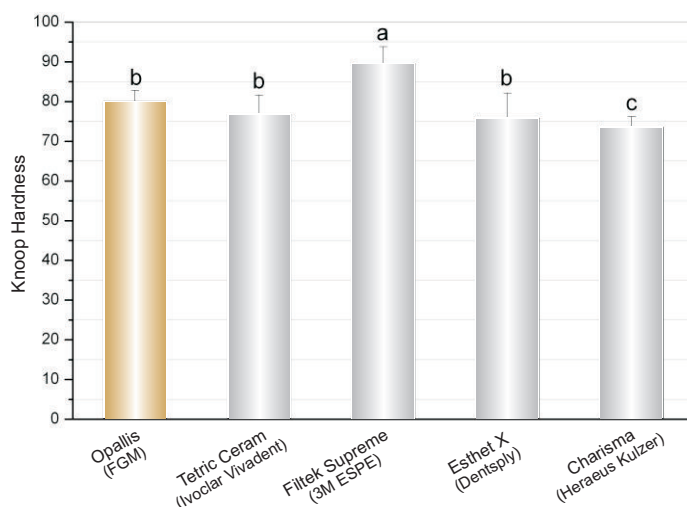


Figura 14: Knoop Hardness.

Courtesy of Dr. Luiz Narciso Baratieri et al. (2005) of the Federal University of Santa Catarina.

5.11 Elastic Modulus

Elastic module represents the capacity of the material to be deformed. A low value of elastic module indicates a more flexible material. Depending on the elastic module, the stress generated by the mastication forces may deform the restorative material and cause resin distortions in the margins. Opallis (FGM) presented statistically superior elastic module when compared to Tetric Ceram, Esthet-X and Charisma resins. Filtek Supreme resin presents elastic module similar to Opallis.

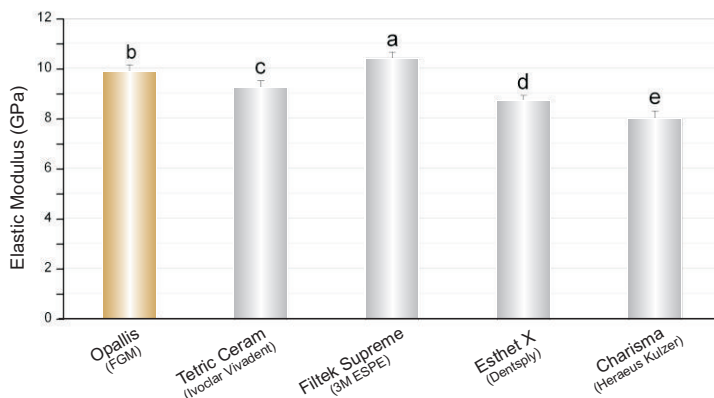


Figure 15: Opallis resin presents elastic modulus superior to Tetric Ceram, Esthetic X e Charisma. Filtek Supreme composite present elastic modulus close to Opallis.

Courtesy of Dr. Luiz Narciso Baratieri et al. (2005) of Federal University of Santa Catarina. According to specifications of ADA n° 27.

5.12 Flexural Strength

As shown in Figure 16, Opallis presents statistically similar flexural strength to the resins Tetric Ceram and Filtek Supreme and superior to the resins Esthet X and Charisma.

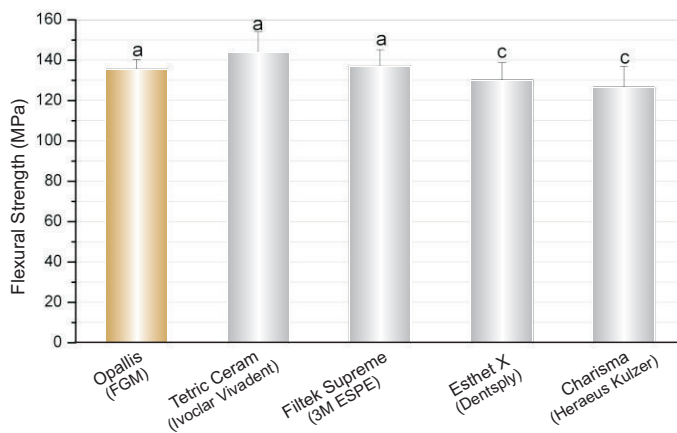


Figura 16: Flexural strength.

Courtesy of Dr. Luiz Narciso Baratieri et al. (2005) of the Federal University of Santa Catarina. According to specifications of ADA n° 27.

5.13 Polymerization Shrinkage

When monomers react to form covalent bonds, there is a decrease in the intermolecular distances and in the free volume, generating contraction of volumetric polymerization (Braga et al. (2005); Truffier-Boutry et al. (2005); Dewaele et al. (2005)).

The higher the conversion degree of monomers into polymers, the higher the polymerization contraction will be. The literature shows that there is a proportionality between conversion degree and volumetric polymerization contraction (Silikas et al. (2000); Panty et al. (2002)). The volumetric polymerization contraction of several resins was determined by the Accuvol™ device, which consists of capturing resin images in the contraction period and, through the software, the conversion of images in percentage of volumetric polymerization contraction is made (Choi et al. (2003); Sharp et al. (2002)). All the tested resins stabilized their polymerization contraction after 10 minutes of light curing. As Illustration 12 shows, Opallis presents intermediate values of volumetric contraction when compared to the resins Esthet X and Tetric Ceram and statistically superior contraction to Charisma.

From the chemical point of view, there must be a balance between the conversion degree and the polymerization shrinkage. During the development of Opallis, the balance of properties was sought after, in other words, the aim was to reach appropriate results in the different parameters that a resin should comply with, and with no detriment of other properties.

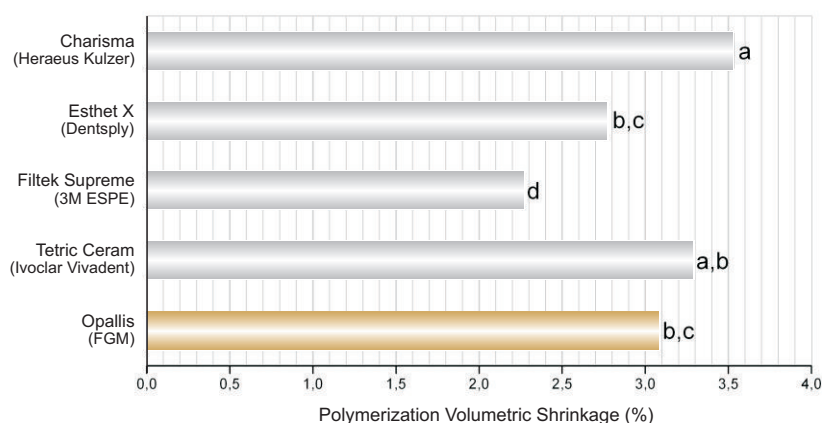


Figure 17: Polymerization shrinkage of Opallis and other commercial resins. Results obtained after a 10 minute polymerization through image capture using the Accuvol™ device.

Courtesy of Dr. Luiz Narciso Baratieri et al. (2005) of Federal University of Santa Catarina.

5.14 Dentin Bond Strength

Dentin bond strength studies were accomplished at the University of Dentistry of Bauru (USP) with Prof. Dr. R. M. Carvalho. In this study, different adhesives were used as well as the composite resins Opallis and Tetric Ceram. Figure 18 shows the obtained results and indicates the compatibility of use of such resin-adhesive systems.

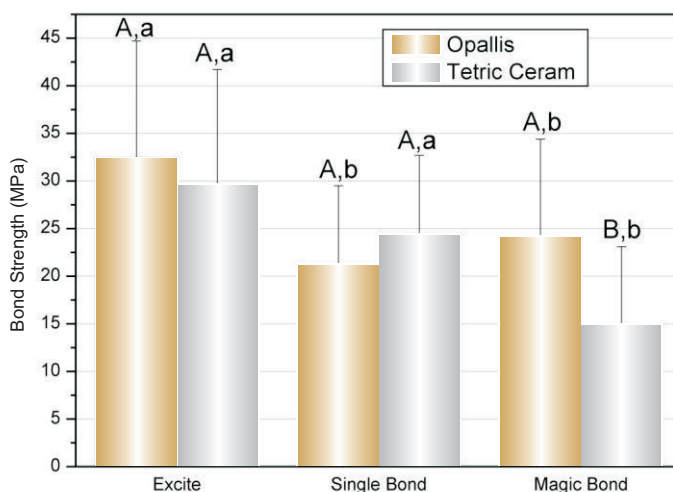


Figura 18: Bond strength among different adhesives, dentin and composite resins.

Courtesy of Dr. Ricardo Marins Carvalho of the University of São Paulo.

5.15 Sensitivity to Light

The art of perfectly recreating the lost part of a tooth requires a composite resin which offers the practitioner the necessary colors and effects to reach this aim. Besides, art takes time, and an esthetically imperceptible restoration should be accomplished without pressure or stress. The light of the dentist's reflector contains a blue component in its spectrum which contributes to initiate the polymerization of a composite resin, thus hindering the restoration finish. For this reason, the sensitivity to light of Opallis was optimized to offer the professional the necessary working conditions to conclude the restoration with wealth of details.

The Figure 19 compares the working time of several commercial brands, according to the norm ISO 4049. It is observed that the Opallis resin presents the longest time in comparison to the other tested brands when kept in the light of the reflector.

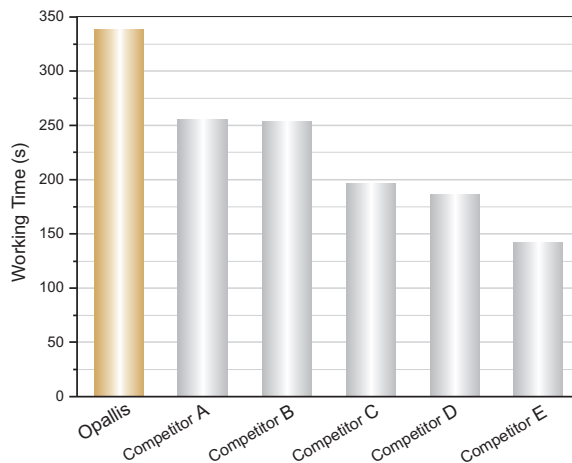


Figure 19: Working time of several commercial brands of color A2 enamel in the light of a reflector (8000 Lux).

Source: FGM Produtos Odontológicos Ltda, according to norm ISO 4049.

5.16 Translucence Level

Due to the different translucence degrees of dentin and enamel, it is necessary for the restorative material to also present translucence options, thus allowing the dentist to recreate the color and depth effects of the natural tooth. The colors of Opallis present four translucence levels that, when used appropriately, supply the tools for the dentist to recreate the lost part of the tooth with wealth of details.

The enamel effect colors present high translucence, offering depth effect to the tooth. This characteristic is due to the capacity of such resins to transmit light and to diffuse the colors of internal layers of pigmented enamel and opaque dentin. The translucence of the enamel and dentin colors was developed and clinically tested to guarantee the reconstruction of the lost parts of the teeth.

Opallis (FGM) offers four extra-opaque effect colors for situations where it is necessary to totally block the passage of light - Opaque White, Opaque Pearl, AO5 and BO5. The image below illustrates the four translucence levels of Opallis resins. It is noticed that the black ribbon is more visible through effect resins, followed by enamel resins, dentin and extra opaque resins. Also, extra-opaque colors have the capacity to mask discolored teeth due to their high opacity. This can be accomplished by using fine layers of the material. The Table below shows the different translucence levels of the colors of Opallis.

Table1: Different translucency levels of Opallis resin shades.

Translucence Level	Translucence %	Application	Available Colors
High translucence	70-80	Effect enamel	T-Blue, T-Yellow, T-Orange, T-Neutral, VH, VM, VL
Medium translucence	55-56	Enamel	EA1, EA2, EA3, EA3.5, EA4, EB1, EB2, EB3, EC2, EC3, E-Bleach H (high), E-Bleach M (medium), E-Bleach L (low)
Opaque	41-44	Dentin	DA1, DA2, DA3, DA3.5, DA4, DB1, DB2, DB3, DC2, DC3, D-Bleach M (medium)
High opacity	33-35	Effect dentin	Opaque Pearl (OP), Opaque White (OW), A0.5, B0.5

The translucence scale varies from 0% to 100% where totally opaque materials present zero translucence and materials which allow the complete passage of light (transparent) present translucence of 100%. Materials with intermediate percentages are called translucent.

The translucence of composite resins depends on their thickness. The values presented in the table above, as well as the comparative analysis of Figure 20 were obtained with constant thickness of the specimens, allowing the comparison among the different analyzed commercial

brands. The translucence values were obtained through measures in a spectrophotometer. The electronic control of the colors and translucence of Opallis allows excellent standardization and reproducibility in every produced batch.

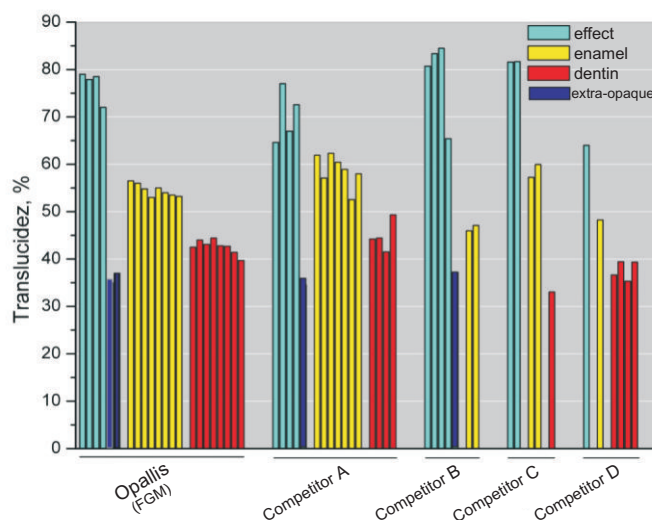


Figure 20: Comparative translucence analysis of several brands of composite resin for effect, enamel and dentin.

Source: FGM Produtos Odontológicos Ltda.

5.17 Toxicity Tests

With the aim of evaluating the *in vitro* cytotoxicity of Opallis, resin specimens were prepared, light cured according to specification, and analyzed as to their cytotoxicity against cells of connective tissue of mice (ATCC CCI-1), according to the norm ASTM F895-84, ISO 10993.5:1992 and US Pharmacopéia XXVIII, 2005. Tests of sharp toxicity and genotoxicity were also accomplished (oral and cutaneous). The composite Opallis was approved in all the tests.

6. Opallis Color System

The enamel and dentin colors of Opallis follow the VITA Classic shade guide. All the colors were carefully adjusted and are strictly controlled in every batch, ensuring the quality of the final product.

To reach such quality level in the adjustment of colors, control, and reproducibility of the resin batches as well as color stability after polymerization, an extensive study was accomplished in which the color of each resin was determined through a spectrophotometer, the data is converted into the CIE L^* , a^* and b^* scale. Figure 21 shows the system of coordinates of the CIE L^* , a^* and b^* scale.

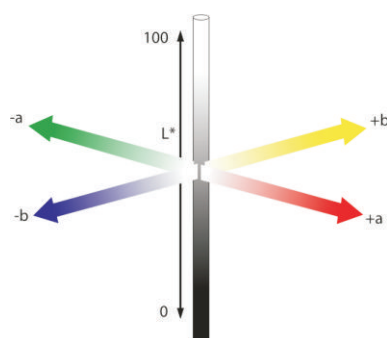


Figure 21: System of coordinates CIE L^* a^* and b^* . Where L^* describes the brightness or color value, a^* denotes the red and green colors, and b^* denotes the yellow and blue colors.

Using the CIE L^* a^* and b^* scale, it was possible to adjust the colors of Opallis (FGM) in a consistent and coherent way. The reading of the color and conversion of the data in the CIE L^* a^* and b^* scale allowed the quantification the color components of the composite resin. Figure 22 show a gradual increase in the red and yellow components along the color scale of the resins for enamel and dentin.

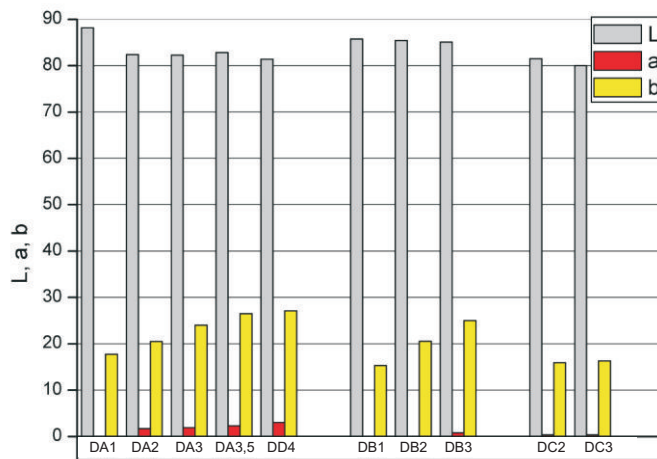


Figure 22: Values of L, a and b of enamel colors of Opallis.

Source: FGM Produtos Odontológicos Ltda.

Enamel and dentin masses of resin are available in a wide variety of colors. However, appropriate combinations of different translucence color masses and colors are possible for every clinical situation.

6.1 Effect Colors

6.1.1 Translucent

The T-Blue color was developed with a slightly bluish characteristic, just as the enamel of the third incisor of young teeth. The T-Orange color contributes in the orange characterization of the tip of the mammelons. The T-Yellow color comes with high translucence, without pigments, and bringing depth to the restoration. It can be used as the last layer without altering the colors of the resins of other layers of the restoration. The T-neutral color resembles incisor colors, it has medium translucence and it is often employed to reproduce the less translucent third incisor.

6.1.2 Value

The dentin mass for value correction were developed with different levels of white/black pigment in order to be used as the outer layer. White teeth and more opaque ones can be reproduced by application of Opallis composite's colors with the last layer being the color VH. The VL color can be used in less white and more translucent teeth, and the VM color to intermediate situations.

6.1.3 Extra-Opaque Colors

The extra opaque colors, Opaque White (OW), Opaque Pearl (OP), B0,5 and A 0,5, are useful in the masking of discolored teeth. Fine layers of such resins promote the masking of the dark bottom. Typical cases of "half moon" cavities are solved by using extra-opaque resins which block the passage of light through the tooth. The OW color comes with a high level of white pigment, the OP color is of equal opacity, however, it resembles the A2 color of the Vita scale; B 0,5 and A 0,5 are clearer colors than B1 and A1 respectively, however, with very high opacity. These two colors can also be used in the reconstruction of primary teeth due to the high opacity of such tissues.

6.1.4 Bleach Colors

The bleach colors were especially developed to reconstruct bleached teeth where the chroma is below the colors foreseen in the Vita shade guide, in other words, lighter than A1 and B1 colors. Opallis contains three colors to reproduce enamel, divided in E-Bleach H, E-Bleach M, and E-Bleach L. The terms H, M and L define the chroma order. H refers the lightest color (high) and L refers to the higher chroma color (low). In order to reproduce dentin, the D-Bleach color was developed with similar opacity to the dentin colors.

7. Concluded Research Projects

Research 1: Study of Fluorescence of Composite Resins.

Authors: Marcos Kenzo Takahashi, Evelise Machado de Souza
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Nowadays dentists are constantly challenged to recuperate lost tooth tissue or even modify it by using restorative materials. The choice of materials with appropriate fluorescence and opalescence in addition to an extensive range of colors and opacities, respecting the product indication of and the disposition of the layers, will result in a restoration of natural aspect and foreseeable longevity. Human maxillary central incisor teeth in healthy conditions were used to make enamel and dentin specimens separately, as controls. The fluorescence readings were accomplished in a fluorescence spectrophotometer (F-4500 - Hitachi High-Technologies Corp., Tokyo, Japan), with registration of the fluorescence intensity of the composite resins, enamel, and dentin in the form of graphs. The peaks of fluorescent emission were around 440 nm in wavelength indicating that, when stimulated by ultraviolet light in the range of 380 nm, these materials emitted visible light with colors between violet and blue. The averages of the fluorescence intensity values were between 420 nm and 470 nm in wavelength and were statistically calculated and analyzed. Figure 24 shows disks made with the same composite resins and analyzed by spectrophotometry, separately or overlapped, in ultraviolet illumination. Outstanding differences are noticed between the different composite resins regarding their fluorescent capacity, as well as differences between the three opacities of a same composite resin.

Conclusion

The composite resins for dentin which presented fluorescence values of similar intensity to human dentin were Charisma OA2, Esthet-X A2O and Opallis DA2 (Figure 23). The translucent and enamel resins Esthet-X and 4 Seasons presented even higher fluorescence intensities than human dentin. The A2 dentin resin from the brand Vit-I-escence presented extremely high fluorescence when compared to the others and to human dentin. The composite resins Esthet-X for dentin, Vit-I-escence translucent and for enamel, besides Opallis (FGM) and Charisma in all the opacities, presented fluorescence intensity comparable to human dentin. All the evaluated translucent and enamel resins differed statistically from the fluorescence values of human enamel.

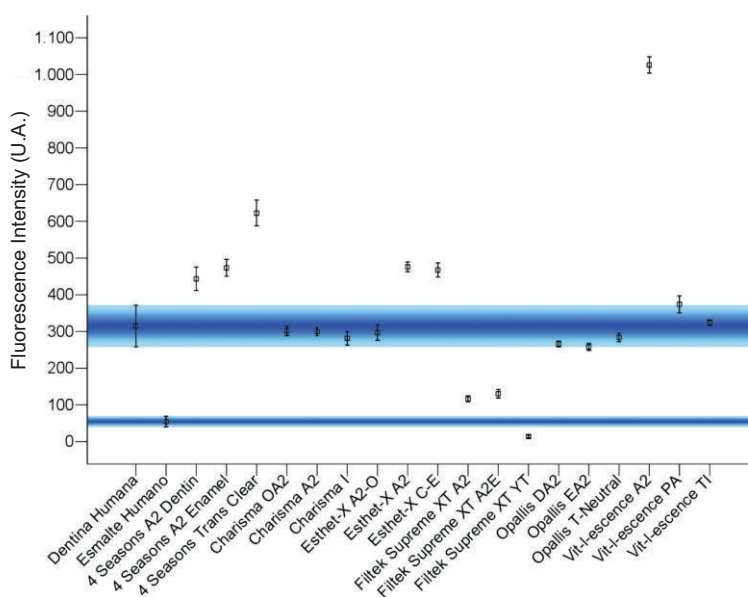


Figure 23: Confidence Intervals of the Analyzed Resins. In the blue bars, the range of fluorescence emission of enamel and dentine.

Courtesy of Dr. Marcos Kenzo Takahashi and Evelise Machado de Souza, PUC-PR.

Table 2: Materials used in the study

Composite resin	Manufacturer	Dentin	Enamel	Translucent
4 Seasons	Ivoclar Vivadent Schan, Liechtenstein	A2 Dentin	A2 Enamel	Trans Clear
Charisma	Heraneus Kulzer GmbH 7 Co Hanau Alemanha	OA2	A2	I
Esthet-X	Dentsply /Caulk Hanau Alemanha	A2-0	A2	C-E
Filtek Supreme XT	3M ESPE St Paul, MN, USA	A2	A2	Y-T
Opallis	FGM Produtos Odontológicos Joinville,SC, Brasil	DA2	EA2	T-Neural
Vit-I-escence	Ultradent Products Inc. South Jordan, UT, USA	A2	Pearl Amber	Trans Ice

Table 3: Fluorescence Intensity (standard deviation) of composite resins, human dentin and enamel

		Dentina	Esmalte	Translucido
Composite Resin	4 Seasons	443,27 (31,29)	473,52 (22,22)	622,49 (34,19)
	Charisma	301,17 (12,02)a	299,60 (10,14)a	281,28 (17,86)
	Esthet-X	296,91(20,76)a	475,92 (13,00)	467,43 (18,98)
	Filtek Supreme XT	116,45 (7,75)	130,38 (11,44)	13,83 (3,84)
	Opallis	266,07 (7,70)a	257,97 (9,74)a	284,01 (11,16)
	Vit-I-escence	1025,88(21,61)	373,89 (22,90)a	324,08 (7,53)
Control	Human Dentin		314,76 (54,82)a	
	Human Enamel		54,67 (14,19)b	

Groups with the same letters do not present statistically significant differences (p > 0,05).

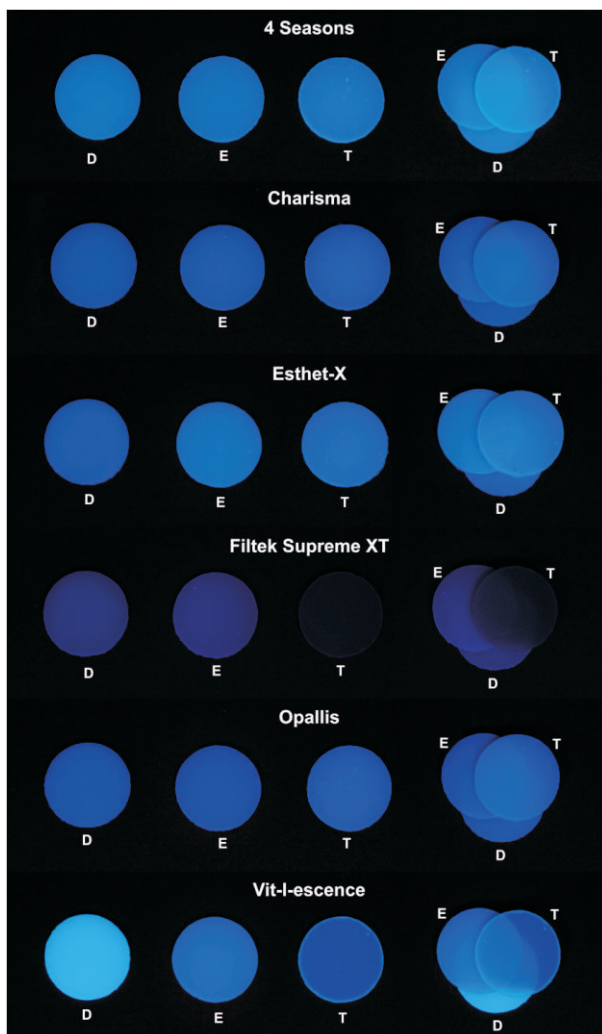


Figura 24: Image of the Composite Resin Disks Used in the Study. In ultra-violet illumination. D= Dentin, E= Enamel, T= Translucent.

Courtesy of Marcos Kenzo Takahashi and Evelise Machado of Souza, PUC-PR.

Research 2: Visual Perception of the Color Difference Between Several Composite Resins and the Vita Classical Shade Guide.

Authors: Tatiana P. Rodrigues, Leonor de Castro M. Loffredo, Alessandra N. S. Rastelli, Juliana A. D. B. Campos, Vanderlei S. Bagnato, Valéria M. Longo, Edson Longo - Chemical Institute of Federal University of São Carlos - Dentistry University of Araraquara - UNESP

The purpose of this study was to evaluate the color difference between the Vitapan Classical shade guide and several composite resins through the CIE L*a*b* system. The sample was made of 132 specimens in A3 shade and in circular metallic matrix with 8mm of diameter and 1mm of thickness, using the following composite resins CR1: OPALLIS (FGM); CR2: Concept Advance (Vigodent); CR3: Z-100 (3M/ESPE); CR4: Palfique Estelite (J. Morita USA Inc.); CR5: Helio Fill (Vigodent); CR6: Fill Magic (Vigodent); CR7: Charisma (Heraeus-Kulzer); CR8: Tetric Ceram (Ivoclar/Vivadent); CR9: Durafill (Heraeus-Kulzer); CR10: Filtek Supreme (3M/ESPE); CR11: Esthet-X (Dentsply). The quantitative measurements of color were accomplished through the CIE L*a*b* system and the complete color difference between the Vitapan Classical shade guide and the composite resin was calculated. Medium values for ΔE^* (95%IC), from CR1 to CR12 were, respectively, 1,23 (0,84-1,62); 1,27 (1,03-1,51); 1,86 (1,63-2,09); 1,59 (1,12-2,06); 1,64(1,48-1,80); 1,14 (0,83-1,44); 2,50 (2,14-2,86); 6,48 (6,03-6,92); 2,58 (2,14-3,02); 1,16 (0,98-1,34) and 6,64 (6,32-6,96). The obtained results are displayed in the graph that follows. It was observed that eight of the analyzed composite resins (CR1, CR2, CR3, CR4, CR5, CR6, CR7, CR9 and CR10) don't differ visually from the Vitapan Classical shade guide and that two of the resins (CR8 and CR11, Tetric Ceram and Esthet-X, respectively) present perceptible differences to the human eye.

Conclusion

It was concluded that the Vitapan Classical shade guide is not indicated as an aid in the visual selection of the dental color for direct aesthetic restorative procedures accomplished with Tetric Ceram and Esthet-X. The other brands including Opallis follow the Vitapan Classical shade guide with fidelity.

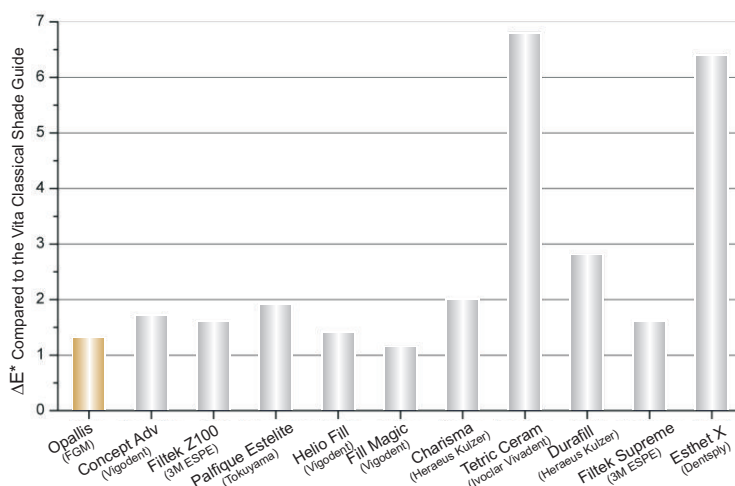


Figure 25: Complete color differences of A3 composite resins compared to the Vita Classical shade guide, where $\Delta E^* = [(L^*)^2 + (a^*)^2 + (b^*)^2]^{1/2}$.

Courtesy of Tatiana P. Rodrigues, UNESP - Araraquara.

Research 3: Laboratorial Evaluation of Bond Strength of Two Restorative Composite Resins for Dentin, Mediated by Different Adhesive Systems.

Authors: Ricardo M. Carvalho, Associated Teacher, Prosthesis dept.
 Thiago Amadei Pegoraro, DDS, Student of Master's Degree in Prosthesis.
 University of São Paulo - USP/Bauru

The objective of this work was to evaluate the influence of an adhesive type combined to different composite resins regarding dentin bond strength.
 Specimens were prepared using extracted human third molars, the application of the adhesive and composite resin followed the manufacturers' recommendations. The teeth were sliced into sticks, with a transversal section area of approximately 0,8 mm², and submitted to micro-tensile tests. The results are presented below.

Table 4: Values of dentin bond strength according to the employed resin and adhesive.
 Values in MPa ± DP (N).

Materials	Excite	Optibond	Single Bond	Magic Bond
Tetric	29,6 ± 12,1 (54) ^{Aa}	30,2 ± 10,6 (50) ^{Aa}	24,3 ± 8,4 (51) ^{Aa}	14,9 ± 8,2 (47) ^{Ab}
Opallis	32,4 ± 12,3 (55) ^{Aa}	22,1 ± 9,2 (44) ^{Bb}	21,2 ± 8,3 (53) ^{Ab}	24,1 ± 10,3 (50) ^{Bb}

Same capital letters indicate absence of statistical significance between resins for the same adhesive (comparison in column), p>0,05.
 Same small letters indicate absence of statistical significance between adhesives for the same resin (comparison in line), p>0,05.

Table 5: Fracture mode of the tested specimens (%).

Material/Failure	Adhesive	Mixed	Cohesive
Tetric + Magic Bond	50%	50%	-----
Tetric + Excite	37,5%	62,5%	-----
Tetric + Optibond	29,15%	62,5%	8,35%
Tetric + Single Bond	31,25%	68,75%	-----
Opallis + Nagic Bond	30,45%	62,5%	4,35%
Opallis + Excite	-----	63,63%	36,37%
Opallis + Optibond	36,35%	54,55%	9,1%
Opallis + Single Bond	33,33%	66,67%	-----

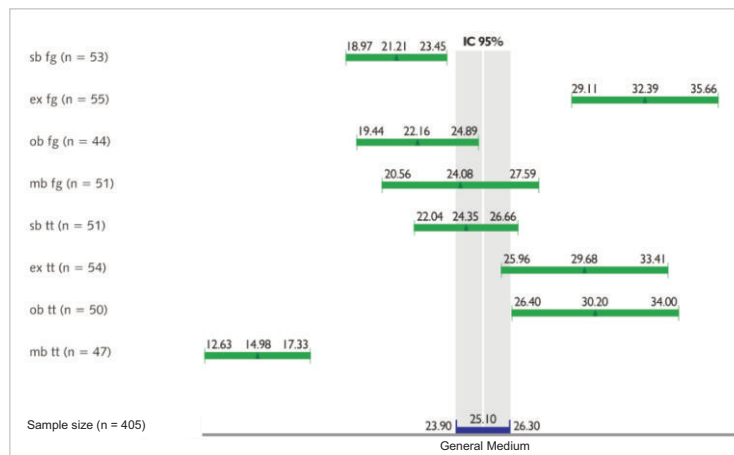


Figure 26: Analysis of the positioning of the confidence interval (IC 95%) of different experimental groups, in relation to the general average of the groups. Discriminant analysis between Opallis and Tetric Ceram samples.

The CI (95%) of the sample mb tt (Magic Bond/Tetric Ceram) is well detached from the others. The same occurs, although less intensely, with the CI (95%) of the ex fg (Excite/Opallis) sample. The general average of all the samples is at the bottom in blue.

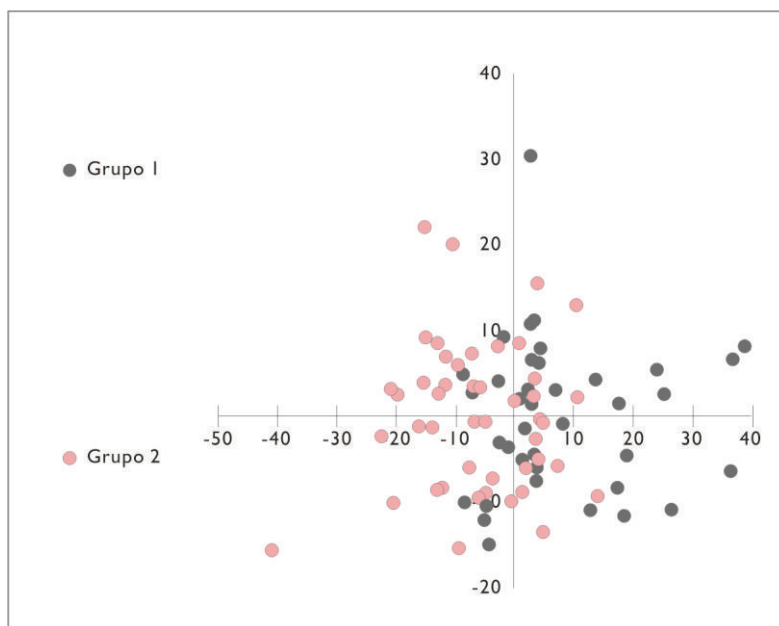


Figure 27: The samples of the variable Opallis (Group 1) are not well discriminated from the samples of the variable Tetric Ceram (Group 2). There are overlaps of several units between the Groups.

Interpretation

The analysis of Table 1 indicates that there is no preponderance of influence of resin type or adhesive type regarding dentin bond strength. One cannot foresee the behavior superiority or inferiority of the different combinations in function of one of the variables. For the Optibond adhesive, there was a significant superiority of bond strength values when the Tetric Ceram resin was used ($p < 0.05$). On the other hand, for the Magic Bond adhesive, there was a significant value superiority of adhesive resistance when the Opallis resin was used ($p < 0.05$). For the other two employed adhesives (Single Bond and Excite), there was no significant difference between the values of bond strength when Opallis or Tetric Ceram resins were used. The dentin bond strength of a composite resin, mediated by an adhesive system, is primarily determined by the quality of adhesion offered by such adhesive and secondarily by the characteristics of the resin. It is known that the employment of a same adhesive system in combination with different composite resins can determine different values of bond strength (Erickson et al., 1989). One of the factors which determine such difference is related to the mechanical properties of the resin. A resin which presents inferior mechanical properties can determine inferior values of bond strength. The data of this study indicate that this factor was not responsible for the differences found in the adhesive groups Optibond and Magic Bond. Even in an indirect way, the results suggest that there is no superiority of mechanical properties of one resin over another, since the employment of a certain resin did not always determine larger values of bond strength with the different adhesives. As such, the eventually found differences can be explained by differences in the copolymerization quality between the radicals of the adhesive and of the resin. The lack of knowledge of the complete chemical structure of the materials impedes a more detailed analysis of such factors. Still in this context, the analysis of Graph 1 demonstrates that only the Group Magic Bond/Tetric Ceram is quite detached from the general average and it does not present intersection of its confidence interval (CI 95%) with any of the other evaluated groups. This indicates an effective inferiority of such combination in relation to the others and it may support the non indication of Tetric Ceram resin to be used with Magic Bond adhesive. The cause of such result is probably related to the possible copolymerization inferiority between the components of Magic Bond with Tetric Ceram, not implicating in isolated inferiority of the adhesive or the resin since the behavior of both materials in the other combinations was not detached from the general average. The same reasoning can be applied to the Optibond Group, in which significant differences of bond strength

between the two resins were observed. Even if this result could suggest superiority of the Tetric Ceram resin over Opallis, the intersection of the confidence intervals of the Optibond/Tetric group with the Excite/Opallis group, both with values above 30 MPa and not different from each other, suggests that the inferiority of the Optibond/Opallis group in comparison with the Optibond/Tetric group is not related to the inferior mechanical properties of Opallis, but probably to differences in the copolymerization mechanism of the resins with that adhesive or simply related to experimental chance.

The analysis of the fracture mode (Table 5) suggests some interesting information. The largest percentage of cohesive fractures for each resin occurred exactly in the groups where the medium values of bond strength were numerically superior (Opallis/Excite and Tetric/Optibond). When analyzing the other groups where there were also cohesive fractures in the resin, it can be speculated that, within the same testing conditions, both resins would present medium resistance to traction values of about 20 to 30 MPa, with a slight superiority of Tetric Ceram resin over Opallis resin. The high percentage of adhesive flaws in the Tetric/Magic Bond group (50%) and the absence of adhesive flaws in the Opallis/Excite group reinforces the suggestion that the combination of Tetric Ceram with the Magic Bond adhesive (smaller average medium values of adhesive resistance) can be affected by copolymerization problems between both materials. On the other hand, Opallis seems to present great interaction with Excite adhesive and such strong bond transfers the fracture sites to more fragile areas, increasing the percentage of flaws in the resin.

Generally, except for the combination between Tetric Ceram resin and Magic Bond adhesive, it can be stated that there are no strong indications which would justify the limitation of Opallis use with all the tested adhesives and of the Tetric Ceram resin with Excite, Optibond and Single Bond adhesives. The discriminant analysis presented in Figure 27 supports such statement, demonstrating several overlaps of experimental units between the Groups.

Conclusion

The results demonstrate that, except for the combination between Tetric Ceram resin and Magic Bond adhesive, there are no restrictions for the employment of Opallis or Tetric Ceram with the adhesives tested in this study. The similarity of results observed in the discriminant analysis supports the concept that the eventual structural differences of the resins were not decisive in the value differences of bond strength.

Research 4: Year Evaluation of the Clinical Performance of Opallis Composite Resin: Class II and V Restorations.

Authors: Bernardon JK, Ferreira KB, Baratieri LN
Federal University of Santa Catarina/UFSC.

Through a randomized study with aim of evaluating in vivo the 1 year clinical performance of Opallis composite resin, 70 restorations were made: being 35 Class II restorations, indicated as replacement of unsatisfactory amalgam or composite resin restorations and 35 Class V restorations of non-cariou lesions. The restorations were accomplished using Singlebond adhesive system (3M ESPE) and Opallis composite resin (FGM) incrementally. Each increment was light cured for 30 seconds with a halogen light device of 550mW/cm². The Class II and V restorations were directly appraised by two previously calibrated examiners in the baseline and 1 year periods according to the modified criteria of the United States Public Health Service (USPHS) of Ryge and Cvar: postoperative sensitivity, marginal integrity, discoloration of the cavo-surface angle, color stability, wear, stressful occlusion and periodontal health. Inter-proximal contact and recurrent caries were specific criteria for Class II restorations, while the surface texture criterion was specific for Class V restorations. For each criterion, the Alpha (A) classification was used to indicate the highest degree of clinical acceptance and, in regressive order of clinical acceptability, the classifications Bravo (B), Charlie (C) and Delta (D) (Chart 2) followed. With the intention of clarifying possible doubts that would arise during the clinical evaluation, digital intra-oral pictures

of the restorations were taken in all the appraised periods. Moreover, as an auxiliary mean of evaluation, inter-proximal x-rays of Class II restorations were taken.

Chart 2: Criteria and indexes used for the evaluation of class II and V restorations.

Criteria USPHS	Index	Definition
Postoperative sensitivity	A	- None.
	B	- Present.
Marginal Integrity	A	- No visible fissures along the margin.
	B	- Visible evidence of fissures and absence of dentinal exposure.
	C	- Probe retention in the fissure and dentinal exposure.
	D	- Dislocated restoration, fracture.
Discoloration of the cavo-surface angle	A	- No discoloration present.
	B	- Surface discoloration.
	C	- Deep discoloration.
Color stability	A	- Similar to the adjacent tooth structure in color and translucence.
	B	- Difference in color and translucence compared to the adjacent tooth structure (clinically acceptable).
	C	- Difference in color and translucence compared to the adjacent tooth structure (not clinically acceptable).
Wear	A	- Restoration in continuity with the existent anatomical form.
	B	- Restoration in discontinuity with the existent anatomical form but the loss of material was not enough to expose the dentin.
Stressful occlusion	A	- No evidence of stressful occlusal contacts.
	B	- Evidence of stressful occlusal contacts.
Periodontal health	A	- Preserved periodontal health.
	B	- Alteration in periodontal health.
Surface texture**	A	- Maintained.
	B	- Altered.
Inter-proximal contact*	A	- Slight contact between the restoration and the adjacent tooth hindering the passage of dental floss.
	B	- Slight contact between the restoration and the adjacent tooth not hindering the passage of dental floss.
	C	- There is no contact between the restoration and the adjacent tooth.
Decay recurrence*	A	- Caries absence.
	B	- Caries evidence in the restoration margin.

*Specific criterion for class II restorations

**Specific criterion for class V restorations

Results

For the statistical analysis of the results, the Binomial test was used at the significance level of $p < 0,05$. In the Class II and Class V restorations, all the analyzed criteria were restricted to the classifications A or B. There were no statistically significant differences found between the baseline and 1 year evaluation periods in none of the appraised criteria. The results found for Class II restorations are represented in Table 6 and Figure 28 and the results for Class V are in Table 7 and Figure 30.

Table 6: Percentual values of index A (%A) obtained in the evaluation criteria of Class II restorations with Opallis composite resin, in the baseline and 1 year periods.

Criteria USPHS	% A baseline	% A 1 year	Binomial Test (value of p)
Postoperative sensitivity	95%	100%	p-0,25
Marginal Integrity	100%	100%	*
Discoloration of the cavo-surface angle	100%	97%	p-0,25
Inter-proximal contact	95%	93%	*
Recurrent caries	100%	100%	*
Wear	100%	100%	*
Stressful occlusion	100%	100%	*
Periodontal health	100%	100%	*
Color Stability	90%	90%	p-0,25

*In these criteria, A index was obtained in 100% of the cases, the application of a statistical test was not necessary.

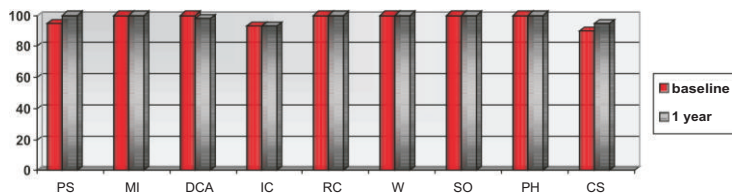


Figure 28: Class II restorations: percentual values of index A (%A) in the baseline and 1 year periods.

PS: Postoperative Sensitivity; MI: Marginal Integrity; DCA: Discoloration of the Cavo-surface Angle; IC: Inter-proximal Contact; RC: Recurrent Caries; W: Wear; SO: Stressful Occlusion; PH: Periodontal Health and CS: Color Stability.



Table 7: Percentage values of A index (%A) obtained on evaluation criteria of class V restorations with Opallis composite resin, on baseline and 1 year periods.

Criteria USPHS	% A baseline	% A 1 year	Binomial Test (value of p)
Postoperative Sensitivity	100%	100%	*
Marginal Integrity	100%	98%	p - 1
Discoloration of the cavo-surface angle	100%	100%	*
Wear	100%	93%	p - 0,25
Stressful Occlusion	100%	98%	p - 1
Periodontal Health	100%	100%	*
Color Stability	93%	95%	p - 1
Surface Texture	100%	100%	*

*In the criteria above, A index was obtained in 100% of the cases, the application of a statistical test was not necessary.

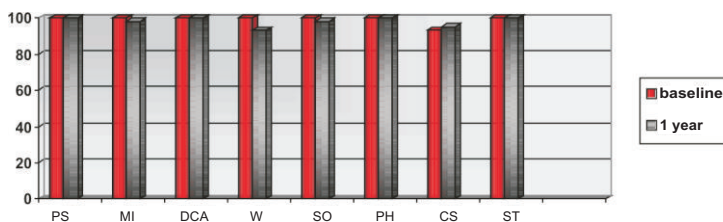


Figure 30: Class V restorations: percentual values of index A (%A) in baseline and 1 year periods.

PS: Postoperative Sensitivity; MI: Marginal Integrity; DCA: Discoloration of the Cavo-surface Angle; W: Wear; SO: Stressful Occlusion; PH: Periodontal Health; CS: Color Stability and ST: Surface Texture.



Discussion

Generally, the results observed in this randomized clinical study evidence the satisfactory performance of the Opallis composite when employed in Class II and V direct adhesive restorations. No statistically significant difference ($p < 0,05$) was observed in any appraised criterion after 1 year of clinical evaluation, which attest to the promising results previously found in the laboratorial tests. Regarding the color stability of Class II and V restorations, the percentual increase of index A in the baseline period compared to the other appraised periods represented a higher similarity between the color of the restoration and the adjacent tooth structure in the course of time. That is due the expected re-hydration of the tooth which occurs after the accomplishment of adhesive restorative procedures with composite resins. Stressful occlusion was observed in only one tooth after one year of clinical evaluation. This may justify the marginal gap without dentinal exposure observed in only one Class V restoration accomplished in that same tooth. The wear evidenced in 7% of Class V restorations was not due to the composition of the material. The excessive force applied in brushing, which was reported by these patients despite having received clear instructions on oral hygiene and brushing techniques, explains the excessive wear of such restorations.

Conclusion

There was no statistically significant difference ($p < 0,05$) observed in any of the appraised criterion after one year of Opallis clinical evaluation, attesting the promising results previously found in the laboratorial tests and now also clinically reached. Opallis presents requirements which completely satisfy the functional and aesthetic demands of adhesive restorative materials suitable for anterior and posterior teeth. The aesthetic resources of Opallis have been thoroughly advertised and attested by several researchers. The long-term clinical stability of Opallis along time has been attested through this work.

Research 5: Comparative Evaluation of Physical-Mechanical Properties of Different Composite Resins.

Authors: Jussara Bernardon, L. N. Baratieri

Dissertation (Master's degree in Dentistry - Option: Dentistry, 2007) Program of Master's degree in Dentistry, Federal University of Santa Catarina, Florianópolis.

Summary

The objective of this work was to evaluate the volumetric concentration and mechanical properties of 6 hybrid composite [Opallis (O), Filtek Z250 (FZ), Tetric Ceram (TC) FillMagic (FM), Esthet X (EX) Charisma (CH)] and a nanocomposite [FiltekSupreme (FS)]. The volumetric concentration percentual of 15 μ l volume samples ($n = 5$) was determined through a video monitoring mechanism (Acuvol, Basco) after 10 minutes of light curing the composite with a halogen light device (Optiluz 501 with 600mW/cm²) and during the time recommended by the manufacturer. The diametral compressive strength, flexural strength, and elastic modulus were determined following ADA specification no. 27. For the compressive test, samples were made with 3 mm of diameter and 6 mm of height. The ANOVA and Tukey tests revealed statistically significant differences ($p < 0,05$) between the appraised materials in all the accomplished tests, which presented the following results in decreasing order of averages: 1- volumetric concentration (CH) > (TC) > (FM) > (O) > (EX) > (FZ) > (FS); 2- compressive strength: FZ = O > = CH > = EX > = FM > = TC > = FS, however FS = CH; 3 diametral compressive strength: FS = FZ = O > TC = FM > EX = CH; 4- flexural resistance: FZ > FM = TC = FS = O > EX = CH e 5-elastic modulus: FZ > FS > O > TC > EX = FM > CH. The results attested that the composition of the material directly influenced the physical-mechanical behavior of the composites. Generally, the resins with larger load content (Filtek Z250, Filtek Supreme and Opallis) presented the best results between the tested materials.

Research 6: Evaluation of Abrasive Wear Resistance of Universal Composite Resins.

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 Dissertation (Master's degree in Dentistry - Option: Dentistry) Program of
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Summary

The aim of this in vitro study was to evaluate the wear strength of universal composite resins Charisma/CH (Heraeus Kulzer), Esthet-X/EX (Dentsply Caulk), Fill Magic/FM (Vigodent), Filtek Supreme/SU (3M ESPE), Filtek Z100/ Z1 (3M ESPE), Filtek Z250/Z2 (3M ESPE), Herculite XRV/HE (Kerr Dental), Opallis/OP (FGM), Teeconom/TN (Ivoclar Vivadent) and Tetric Ceram/TC (Ivoclar Vivadent). Eight cylindrical specimens (8mm diameter, 2mm thickness) of composite resin (A2 shade) were made for each material. Wear strengths were evaluated by mass and surface roughness changes of the specimens subjected to simulated brushing. Baseline (prior to simulated toothbrushing) and final (after simulated toothbrushing) measurements were obtained using a precision electronic balance with .0001g accuracy. Baseline and final surface roughness measurements were made using a 5µm probe attached to a profilometer (Perthometer S8P, Mahr) at 0.15mm/s speed, 0.8mN load, Ra parameter in µm, cut-off 0.25mm and 1.25mm traversing length. Abrasion test was performed in a toothbrushing simulation device, using soft, rounded bristle toothbrushes, 200g loading, 374 cycles/min and a dentifrice/deionized water slurry in a 1:2 proportion. The specimens were subjected to 50,000 brushing cycles. The toothbrushes were replaced each 25,000 cycles and the slurry was continuously replaced throughout the test. Mass loss changes and surface roughness were calculated from the differences between baseline and final mass mean values, and were then converted in percent. Data were statistically analyzed using paired t-Test, one-way ANOVA, Scheffé, and Pearson correlation tests ($p < 0.05$). The results have shown that all the materials presented statistically significant mass loss, and a significant increase of surface roughness after the simulated toothbrushing ($p < .0001$). Regarding the mass changes, the wear strengths of the materials in the increasing order were (OP=Z2) > Z1 > TC > (HE=CH) > FM > TN > SU > EX. The surface roughness in increasing order of the materials were EX > (HE = SU = TC = CH = FM) > (TC = CH = FM = OP) > (OP = Z2 = TN = Z1). The methods of wear strength evaluation did not present correlation. It was concluded that the universal composite resins tested presented statistically significant differences of wear strengths. However, all composites presented wear and increased surface roughness because of the abrasive forces from simulated toothbrushing. Mass loss and surface roughness changes did not present statistic correlation.

Research 7: Color perception of composite resins regarding Vita Shade Guide.

Source: Rodrigues TP, Loffredo LCM, Rastelli ANS, Bagnato VS, Longo VM, Longo E, Campos JADB. Color perception of composite resins regarding Vita Shade Guide.. In: 23rd Annual Meeting of Brazilian Dentistry Research Society, IADR, 2006, Atibaia. Brazilian Oral Research 2006. V.20. p.187.

Objective: This study has the objective of evaluate the difference in shades between Vita Shade Guide and 11 composite resins by means of CIE L*a*b* system.

Materials and Methods: The sample was constituted by 33 specimens in A3 shade made with the aid of a circular metallic matrix with 8mm of diameter and 1mm of thickness, using the following composite resins (A: Charisma, B: Concept Advanced, C: Durafill, D: Esthet-X, E: Fill Magic, F: Filtek Supreme, G: Helio Fill, H: Opallis, I: Palfique Estelite, J: Tetric Ceram and K: Z-100). Quantitative measures of color by means of CIE L*a*b* system were made, determining 3 parameters: L*, a* and b*. Next, it was calculated the difference of the composite and Vita shades, based on difference of each parameter and using the equation given by the CIE.

Results: The following average score values and its respective standard-deviation to composite resins: A= 3,731(0,478), B= 0,896(0,130), C= 1,715(0,228), D= 6,182(0,630), E= 0,899(0,112), F= 1,364(0,080), G= 1,418(0,037), H = 0,911(0,084), I= 3,158(0,280), J= 6,561(0,655), K= 2,213(0,213). According to literature, the total difference of shades is visually imperceptible to human eye and also clinically acceptable when its lower or equal to 3,7. The composites D and J had shade difference perceptible when compared to Vita shade guide, while A was inside the limit of perception.

Conclusion: Thus, it can be observed that 8 of the composites tested do not differ visually from the Vita Shade Guide, while 2 presented different colors, suggesting that manufacturers may have their own shade guide made of the composite material.

Research 8: Influence of finishing time on marginal sealing of direct restorations.

Source: Ramírez JC, Baratieri LN, Lopes GC, Araújo Júnior EM. Influence of finishing time on marginal sealing of direct restorations.. In: 37th AADR Annual Meeting, 2008, Dallas - Texas - USA. The Journal of Dental Research (Abstracts), 2008.

Objective: To verify the influence of finishing and polishing procedures on microleakage of Class V restorations using two different composite resins.

Material and Methods: Sixty Class V cavities were prepared in sound human premolars. One cervical margin was placed in enamel (1mm to the CEJ) and one in dentin (1mm below the CEJ). The teeth were randomly divided in the follow groups: group I were restored with micro-hybrid resin composite Opallis (FGM) – immediate polishing and finishing procedures, group II were restored with Opallis (FGM) – polishing and finishing procedures after 24 hours, group III restored with nanoparticules resin composite Filtek Supreme XT (3M ESPE) – immediate polishing and finishing procedures, group IV with Filtek Supreme XT (3M ESPE) – polishing and finishing procedures after 24 hours. The restored teeth were stored in water at 37°C and subjected to thermocycles (5-55C, 500x, 1min.) before being immersed in 0,5% basic fucsin for 24 h. The teeth were then washed, dried, sectioned and the extent of die leakage was measured and recorded using a 0 - 4 scale. Data were analyzed with the Kruskall Wallis test ($p < 0.05$).

Results: The medians for scores were: G1 – enamel:0, dentin:1; G2 – enamel:0, dentin:0; G3 – enamel:1, dentin: 2; G4 – enamel:0, dentin:1. Comparing the composite resins, Opallis resulted in lower leakage scores on both enamel and dentin margins. Finishing and polishing procedures after 24 hours resulted in better sealing capacity.

Conclusion: The type of composite resin and the time of polishing and finishing procedures influence the microleakage on direct restorations.

8. Instructions

Opallis composite resin is indicated to reproduce palatal enamel and dentin; it may be used in the following situations:

- Restorations of occlusal and/or proximal carious lesions of small and medium size.
- Replacement of occlusal, proximal and occluso-proximal lesions of small and medium size.
- Direct composite resin veneers.
- Class III and IV restorations in anterior teeth.
- Class V Restorations.
- Bonding of teeth fragments.
- To reduce and/or to fill spaces (diastema).
- To correct/alter the form of one or several teeth.
- To correct/alter the proportion length/width of one or several teeth.

- To correct the position of one or several teeth.
- To correct/alter the color of the whole tooth or part of it; in cases of a single tooth as well as of several teeth.
- Structural defects: Amelogenesis imperfecta, enamel hypoplasia, erosion, abrasion, abfraction.

8.1 Color Selection

The prophylaxis should be accomplished before the color selection. The teeth should be clean, hydrated, and without isolation since dehydration may alter its color.

8.1.1 Methods for the Choice of Color

- The choice can be made with the commonly used Vita Classic shade guide.
- A small portion of composite resin can be placed on the facial surface of the tooth to be restored (without conditioning or application of an adhesive system), polymerized for 30 seconds, humidified with the patient's saliva, and observed.
- For the most challenging cases, the professional should initially make a chromatic map of the tooth. The chromatic map is all the most detailed information on the individual characteristics of the teeth.

8.2 Product Application

1. Isolate the operative field. The isolation should guarantee an operative field free of humidity, clean and visible during the whole treatment. If necessary, make an absolute isolation (rubber dam).
2. Make the preparation for the execution of direct adhesive restorations.
3. Make the acid conditioning (CondAc 37%) initially in the enamel margins and soon after, inside the cavity. The time of conditioning is 15 seconds. Soon after, wash with water abundantly, remove all the acid from the dental structure and dry the dentin without dehydrating it.
4. Apply the adhesive system according to the manufacturer's recommendations.
5. Insert and light cure the composite resin:
 - We recommend the technique of insertion and polymerization by increments. Such technique allows a more uniform polymerization facilitating the adaptation of materials to cavity walls, reducing stresses of interfaces in wide cavities, allowing shade stratification and increasing the durability of the restoration. Use the polymerization times described in the first chart of this study for resin layers of up to 1,5 mm.
 - Restore the cavity according to the selected color(s) applying small layers of Opallis (maximum thickness of 1,5mm) and carefully adapting them in the cavity.
 - For finishing and polishing, Diamond Pro sandpaper disks can be used as well as Diamond Flex felt disks with the aid of Diamond ACI and ACII, and Diamond Excel polishing pastes.

Note: Checking the occlusion level is an extremely important factor. Restorations in supra-occlusion cause a very large stress in the tooth and the restoration which may cause pain. Do not leave them in infra-occlusion.

8.3 Precautions and Contraindications

In cases of allergic reactions to the product, interrupt the use. Avoid the use of lining or temporary materials based on eugenol as they may interfere in the polymerization of the material. Avoid the contact of non-polymerized Opallis with the skin, mucous membrane, and eyes. While still non-polymerized, the product can cause a slightly irritating effect and promote sensitivity due to methacrylates.

8.4 Side Effects

The product contains methacrylate monomers which can cause allergic or slightly irritating reactions in patients who are sensitive to such substances.

8.5 Storage and Maintenance

Keep the product in a cool area with the packing always well closed and protected. Protect the product from the incidence of the direct sunlight. Store the product at temperatures from 5 to 30°C / 41-86°F. Do not freeze the product.

8.6 Warnings

Do not use the product if it is expired. Discard the product according to the legislation of your country. Keep out of children's reach.

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