Restorations Inspired by Nature

Esthetic bioactive materials, like ACTIVA™ BioACTIVE from Pulpdent, are changing the way clinicians think about restoratives. These materials create beautiful, durable restorations that mimic nature, promote long-term dental health, and offer benefits that no other materials can match.
As dentists, you know that achieving beautiful restorations that are also long-lasting can be a challenge. You’ve likely tried traditional composites, glass ionomers, and resin-modified glass ionomers (RMGIs), and while they all have their benefits, none of these materials offer everything you and your patients want.

In fact, traditional composite restorations, while much more esthetic, fail at a far higher rate than amalgams. Composites last an average of only 5.7 years¹, mostly because of the degradation of bonding agents that leads to marginal leakage and brown stains, and this costs the American public billions of dollars every year.

That’s why many dentists are making a change. They’re investing in bioactive materials like ACTIVA™ BioACTIVE products from Pulpdent. Rather than being passive like traditional composites, bioactive materials play a dynamic role in the mouth and mimic the physical and chemical properties of natural teeth.

Bioactive materials represent the future of restorative dentistry and will become the standard of care. Interested in learning more? Here’s a look at how these exciting products work, why they’re so important, and the benefits they offer your patients and your practice.

FACT:
Biochemistry only occurs in the presence of water. Only moisture friendly materials that transport water can be bioactive.
What Defines Bioactive Restorative Materials?

“Bioactive” materials meet specific criteria and should not be confused with materials classified as bio-interactive, biomimetic, or biocompatible. Bioactive materials have all these properties and more. Scientific researchers define these terms as follows:

**Bioactive Materials:**
Bioactive dental materials stimulate the natural remineralization process. They are moisture friendly, transport water, and release and recharge essential minerals such as calcium, phosphate, and fluoride. They are dynamic, not passive, and in the presence of saliva they elicit a biological response that forms a layer of apatite and a natural bond between the material and the tooth. These properties are verified by scientific investigation.2,3,4

**Bio-interactive Materials:**
Bio-interactive refers to ion-releasing behavior. This property can be found in materials that do not meet the requirements for bioactivity, such as glass ionomers or fluoride-releasing composites, which do not stimulate apatite formation.6

**Biomimetic Materials:**
Biomimetic materials display natural function and appearance. In restorative dentistry, this property also applies to conventional adhesives and composites that restore tooth function to natural strength and resilience, but are not bioactive.4,5

**Biocompatible:**
A material is biocompatible if it does not cause any undesirable effects in the body.6 All materials should meet this requirement.

The Products:
ACTIVA BioACTIVE products are the first esthetic bioactive dental materials with an ionic resin matrix, a shock-absorbing resin component and bioactive fillers that mimic the physical and chemical properties of natural teeth. The patented rubberized resin absorbs shock and stress and resists fracture and chipping. This eliminates the brittleness found in traditional materials. ACTIVA contains no Bisphenol A, No Bis-GMA and no BPA derivatives. The products look and behave like natural teeth, leading to beautiful, long-lasting restorations.
How Do Bioactive Materials Work?

Unlike traditional restoratives, which are hydrophobic and passive, bioactive materials are moisture-friendly and elicit a response from living tissue, integrating and forming a natural bond with tooth structure. They participate in the dynamic exchange of ions and stimulate the remineralization process, releasing and recharging beneficial mineral components such as calcium, phosphate and fluoride ions.

Just like teeth, bioactive materials respond to pH changes in the mouth. When the pH is low, the demineralization process releases calcium and phosphate ions from both the tooth surface and the bioactive restorative material. When the pH rises, calcium and phosphate ions that are available in the saliva recharge the material and precipitate onto the tooth, forming a layer of apatite. Bioactive materials play a dynamic role and support this natural remineralization process.

This ionic interaction binds the ACTIVA resin to the minerals in the tooth and forms a strong resin-hydroxyapatite complex. The natural remineralization process knits the material and the tooth together, penetrates and fills micro-gaps, protects against secondary caries, and seals margins against microleakage and failure—all factors that support better patient outcomes.
A Smart Choice

ACTIVA is a “smart” material that responds to pH cycles in the mouth. During low pH demineralization cycles, ACTIVA releases more phosphate and calcium ions. These ions have the ability to reside in the pellicle layer or saliva and be available to interact with fluoride ions, thus facilitating the precipitation of fluorapatite layers.

Deposition of Calcium and Phosphate on ACTIVA BioACTIVE-RESTORATIVE and ACTIVA BioACTIVE-CEMENT, EDS Analysis

<table>
<thead>
<tr>
<th></th>
<th>Control</th>
<th>14-days</th>
<th>28-days</th>
</tr>
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<tbody>
<tr>
<td>Phosphorous (Cement)</td>
<td>1.745</td>
<td>5.783</td>
<td>5.485</td>
</tr>
<tr>
<td>Calcium (Cement)</td>
<td>2.805</td>
<td>5.196</td>
<td>4.582</td>
</tr>
<tr>
<td>Phosphorous (Restorative)</td>
<td>1.278</td>
<td>2.603</td>
<td>4.992</td>
</tr>
<tr>
<td>Calcium (Restorative)</td>
<td>1.179</td>
<td>2.956</td>
<td>4.810</td>
</tr>
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</table>

Chart shows increased concentrations of calcium and phosphorous on the surface of ACTIVA Cement and Restorative, in weighted %, at 14 and 28 days compared to the control. Analysis conducted by Energy Dispersive Spectroscopy (EDS).³

Scanning Electron Microscopy (SEM) at 3000x magnification provides visual images of calcium and phosphate precipitation on the surface of ACTIVA BioACTIVE-CEMENT and ACTIVA BioACTIVE-RESTORATIVE at zero days (control), 14 days, and 28 days. The increased mineral content of the surface is validated by EDS analysis (see chart above).³
How is ACTIVA Different from Other Bioactive Materials?

**ACTIVA is the only esthetic bioactive restorative material.**

Calcium based-materials, such as calcium hydroxide, calcium silicate (MTA), and calcium aluminate are bioactive. They are moisture friendly, transport water, release essential minerals, and stimulate apatite formation and the natural remineralization process. They may be suitable for endodontic applications, pulp capping, or as dentin replacement materials; however, they are not esthetic materials, and their physical properties are not suitable for final, esthetic restorations. ACTIVA is esthetic and durable, and it is both a dentin and enamel replacement material.

Why Go Bioactive?

For years, dentists have relied on traditional, passive composite materials to restore form and function to teeth. ACTIVA, a new class of esthetic bioactive materials, offers a dynamic, “active” restorative solution that looks and behaves like natural teeth and has the ability to stimulate formation of a protective layer of hydroxyapatite that helps seal the material-tooth interface and prevent microleakage and failure.

Traditional composites have the strength and esthetics dentists want, but they are not bioactive, release minimal fluoride, and don’t bond chemically to teeth. In fact, they’re hydrophobic and are actually repelled by teeth, forming gaps and compromising the seal. To adhere, they require bonding agents that leave white lines, degrade, and leak at the margins, which causes staining. Eventually, the microleakage results in secondary decay and failure.

Dentist’s Choice

“With Activa, you can restore a tooth in a very short period of time. You’re going to be sure that it’s cured from top to bottom because it is self-curing, light-curing, and able to fill the gaps and voids as well as release bioactive components to help with biomineralization, which helps to seal the tooth.”

—Dr. John Comisi on using ACTIVA BioACTIVE-RESTORATIVE

ACTIVA™ BioACTIVE-CEMENT™ is effective with all substrates, and its ability to absorb shock and stress acts like a ligament to resist fracture and chipping.

51-month recall of case restored with ACTIVA BioACTIVE-RESTORATIVE shows no marginal staining.

Image Courtesy of Dr. John Comisi.
Glass ionomers (GIs) are hydrophilic, release a large amount of fluoride, and chemically bond to tooth structure to seal against bacterial leakage, but they just don’t offer the esthetics patients want. They are soluble, have poor physical properties, do not stimulate formation of a hydroxyapatite layer, and simply don’t last.

Resin-modified glass ionomers (RMGIs) incorporate reactive ionomer glass in a resin matrix. They offer advantages over glass ionomers, including longer working time, controlled setting time, less sensitivity to environmental moisture changes, and improved esthetics and durability, but their esthetics and physical properties do not compare to composites and are not suitable for esthetic restorations.

Traditional glass ionomers and RMGIs are also known for their poor tensile strength, brittleness, and low wear resistance. This, unfortunately, means they can’t be used in some load-bearing, long-term clinical situations.

It comes down to this: traditional restorative materials offer either esthetic composites with very good physical properties but with no bioactive potential, or non-esthetic glass ionomers with the benefit of chemical bonds and high fluoride release but poor physical properties. Esthetic bioactive restorative materials, such as ACTIVA BioACTIVE products from Pulpdent, combine all the benefits of composites, glass ionomers, and RMGIs into one material, enabling dentists to offer patients beautiful, long-lasting restorations that contribute to long-term oral health.

The Tooth is the Standard for Comparison

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Tooth Structure</th>
<th>ACTIVA BioACTIVE</th>
<th>Composites</th>
<th>Glass Ionomers</th>
<th>Giomers</th>
<th>RMGIs</th>
</tr>
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<tbody>
<tr>
<td>Esthetic</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Moisture-Friendly</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Bonding is Optional</td>
<td>n/a</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>High Strength</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Releases Calcium, Phosphate &amp; Fluoride</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>Stimulates Apatite Formation</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
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<tr>
<td>Shock-Absorbing</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
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<tr>
<td>Resists chipping and cracking</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td>No</td>
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</tr>
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FACT: In 2013, Pulpdent introduces the first esthetic bioactive restorative materials.
The Advantages of Pulpdent’s Patented Rubberized-Resin

Pulpdent’s ACTIVA BioACTIVE products feature a shock-absorbing rubberized-resin component that absorbs stress, increases durability, and resists fracture and chipping. This patented technology eliminates the brittleness found in traditional materials. ACTIVA also displays very low water solubility and low water absorption, which increases durability and longevity. The ionic resin matrix and reactive glass fillers mimic the physical and chemical properties of natural teeth, giving patients the optimal function, durability, and esthetics they want.

<table>
<thead>
<tr>
<th>Restorative Material Wear (mm³)</th>
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<tr>
<td>Fuji IX</td>
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<tr>
<td>1.2</td>
</tr>
</tbody>
</table>

The chart above shows wear of several restorative materials.\textsuperscript{12}

Why Bioactive is Better for Your Patients and Your Practice

Being a leader in bioactive materials differentiates your practice from others. The public is increasingly informed about healthcare options, including dental health, and considerable information is available online. Patients want to know that their dentist is up-to-date with the latest developments and techniques.

Introducing ACTIVA to your patients

Discussing the benefits of bioactive materials with patients shows them your commitment to patient education, prevention, and overall health, and strengthens the patient-dentist relationship. Explain that traditional materials are designed to be passive and do no harm, and that they really only fill a space. Bioactive materials promote prevention and play a dynamic role in maintaining oral health. This message resonates with your patients and lets them know you have incorporated advanced materials into your practice that deliver direct health benefits.

FACT:

More than 3 million restorations have been placed with ACTIVA BioACTIVE-RESTORATIVE since the product was launched in 2013. This universal restorative works well for all classes of cavities.
Position your practice for growth

Patients understand prevention and the benefits of proactive care. They will talk about this with their families and friends, and your practice will attract those seeking the best in dental care. Satisfied patients build your dental practice.

Addressing patient concerns about BPA

Some patients are concerned about BPA. ACTIVA is the perfect restorative choice for these patients. ACTIVA BioACTIVE materials contain no Bisphenol A, no Bis-GMA and no BPA derivatives.

Excellence and efficiency

ACTIVA delivers better patient outcomes in less time. Cavity preps with retention form do not require bonding agents, and this provides considerable time savings. ACTIVA is faster to place than traditional heavy body composites, integrates and chemically bonds to tooth structure, eliminates voids and sensitivity, and provides esthetic, durable restorations with exceptional bioactive properties.

Ease of Use

ACTIVA simply makes your job as a dentist easier. It is easy to handle and flows where you want it, making it possible to complete a restoration in a matter of minutes. It molds to the form of the matrix, adapts to the tooth preparation, back fills the cavity, and eliminates the voids that are so common in heavy body materials.

Economic benefits

ACTIVA BioACTIVE-RESTORATIVE can be used for all classes of cavities, and ACTIVA BioACTIVE-CEMENT can be used with all substrates. This simplifies ordering and reduces inventory and waste. Restorations are completed in much less time, and the fact that you don’t need a bonding agent in many cases saves you time and money.

Versatile, dual cure

ACTIVA BioACTIVE materials are suitable for all your restorative needs and are both light-cure and self-cure. This ensures complete depth of cure during bulk fill applications, which may not be the case with light cure only composites. The self-cure option has additional benefits. Allowing dual cure materials to self-cure for 20 to 30 seconds before light curing reduces polymerization stress and exothermic reaction. ACTIVA’s low shrinkage of 1.7% eliminates the gaps that cause problems later—problems that lead to unhappy patients who are likely to start looking for a new dental home. Happy patients become loyal patients who talk up your practice to family and friends, which is why it’s so important to invest in the best materials possible.
Bulk Fill Technique Tips

The ACTIVA syringe technique eliminates the voids common with heavy body composites, and together with low shrinkage and intimate adaptation to tooth structure, it leads to a monolithic restoration without voids or marginal gaps. Here are a few tips for successful bulk fills:

- Place mix tip against the floor of the cavity and allow the material to flow ahead of the mix tip.

- Maintain contact with the floor and move the tip around the box.

- Allow the material to back fill the cavity preparation.

- Keep the tip submerged in the material to avoid air bubbles.

- Allowing the material to self-cure for at least 20-30 seconds before light curing mitigates polymerization stress and exothermic reaction.

Click here for more information on bulk filling with ACTIVA BioACTIVE.
Dentists see too many restoration failures and seek materials that offer strength, beauty, and longevity. Switching from traditional restoratives to ACTIVA BioACTIVE materials can change all that. ACTIVA offers the best of both worlds: it looks like the tooth, integrates and becomes part of the tooth, and protects it from the many complications that cause restorations to fail. ACTIVA delivers the minerals teeth need to stay healthy for a more natural restoration that will stand the test of time.

Esthetic ACTIVA BioACTIVE materials are backed by years of research that show what they can do to improve patient outcomes, helping dentists grow their practices and their bottom lines while providing patients with top-notch care. They represent the restorative solution of the future, and it won't be long before bioactive materials like ACTIVA become the standard of care.

**Research and Clinical Validation**

Numerous university studies validate ACTIVA BioACTIVE’s physical and bioactive properties, and these appear in publications and peer reviewed journals. For a complete list visit [pulpdent.com/education-articles](http://pulpdent.com/education-articles) or download the **ACTIVA BioACTIVE White Paper**.

**References**