

A microscopic view of cells, likely osteoblasts, with prominent red nuclei and blue cytoplasm. A translucent, 3D model of a tooth is overlaid on the right side of the image.

TOOTH REPAIR THE BIOACTIVE WAY

*Bioactive Restorative Materials
in Proactive Dental Care*

BIOACTIVE DENTAL MATERIALS

OVER THE PAST THREE DECADES, dentistry is seeing a shift from reactive treatment of dental disease to a preventive and conservative model with bioactive technologies. This includes biomimetic materials that encourage remineralization of tooth structure and contribute to a patient's long-term health and well-being.^{1,2}

Although many restorative materials are inactive with respect to the biological tissues of the tooth, some are bioactive (interact with or affect the biological tissues). These materials can effectively work with the dental tissues to remineralize and heal them.³

GIOMERS are the latest category of hybrid restorative materials with bioactive attributes, representing the true hybridization of glass ionomer and resin composite:

- the biological effectiveness of glass ionomer (release/recharge of fluoride and other beneficial ions)
- the outstanding physical, mechanical, and optical properties of nano-hybrid composite

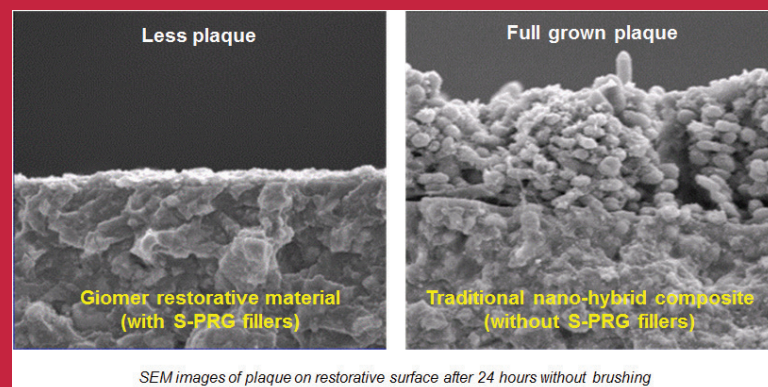
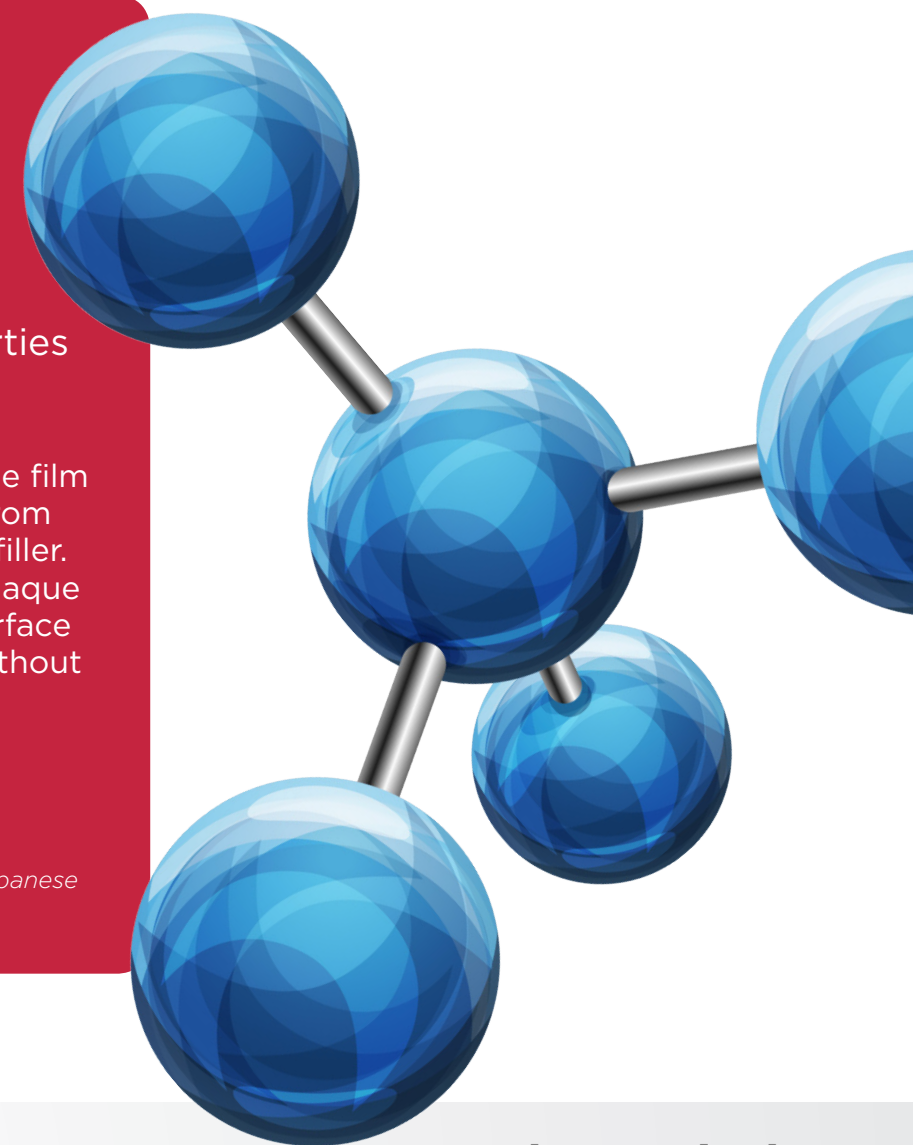


FIG 1. Study of the film layer produced from S-PRG (Giomers) filler. SEM images of plaque on restorative surface after 24 hours without brushing.

Source: Observation of plaque formation in oral cavity (non-brushing for 24 hours). *The Japanese Journal of Conservative Dentistry*. 2004;47(3):391-402.



DEFINING THE FIELD: GIOMER TECHNOLOGY

Restorative materials inclusive of the **Giomer technology** combine clinical benefits of glass ionomer (release and recharge of fluoride and other beneficial ions, ability to inhibit plaque formation and establish a stable pH in the oral environment, thereby decreasing the risk for secondary caries⁵) with superior physical, mechanical and esthetic properties inherent to nano-hybrid materials.

Giomer materials have been clinically vetted in a series of long-term clinical trials.

- An eight-year clinical research study recorded 100% retention rate with intact esthetics, no secondary caries, no failures, and no post-operative sensitivity.⁵
- A thirteen-year recall study demonstrated 96% of restorations with no secondary caries, in a 66% retention rate.⁶

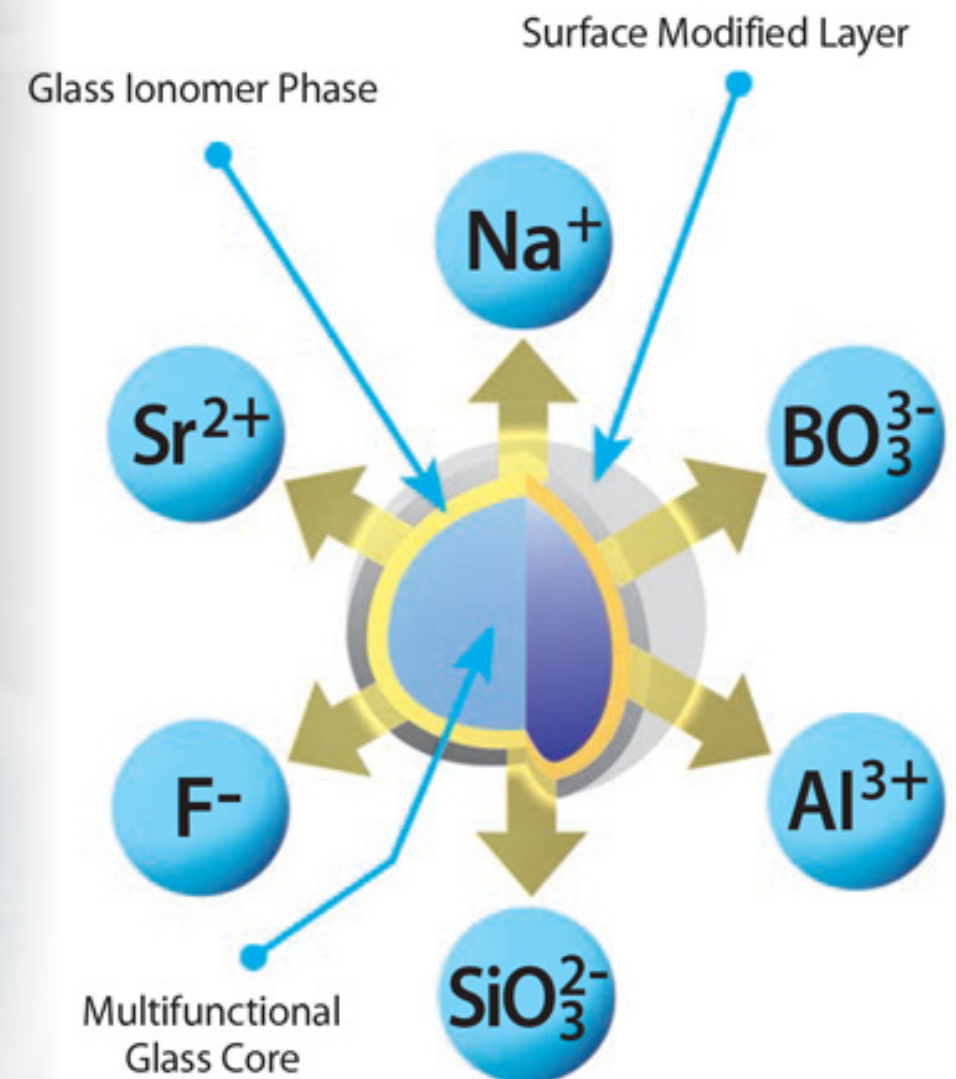


FIG 2. Silicate and fluoride are strong inducers of remineralization of the dentin matrix, while fluoride and strontium act on hydroxyapatite to convert it into fluoro-apatite and strontium-apatite, respectively, which improves the resistance of teeth.⁴

THE GIOMER CONCEPT

This proprietary concept is based on surface pre-reacted glass (S-PRG) technology in which pre-reacted multifunctional fluoro-boro-alumino-silicate glass particles—surrounded by a glass-ionomer phase—are trapped within a polyacid matrix and actively release six beneficial ions: fluoride, strontium, borate, aluminium, silicate, and sodium.

PROACTIVE DENTISTRY WITH GIOMER RESTORATIVE MATERIALS

As the population's demographic makeup continues to evolve, unique clinical conditions become more evident with routine examinations. Many patients exhibit rampant root decay and cervical erosion, often due to the use of medications causing xerostomia, or oral habits that promote tooth loss. These conditions can be minimized by the use of restorative materials that are bioactive.

For example, a highly filled nanohybrid composite with **Giomer** chemistry, **Beautifil II**, delivers restorations that resemble natural teeth, and are reversible and cost-effectively repairable.

This fluoride-releasing-and-recharging bioactive composite demonstrates enhanced thixotropic properties for excellent marginal adaptation and efficient contouring without slumping or sticking.

The material's high compressive and flexural strength, whether placed in the anterior or posterior regions, is ideal for preserving long-term functional stability in the oral environment.



FIG 3. Chameleon-like optical attributes of Beautifil II shades facilitate achieving highly esthetic results. Class V restoration completed with Beautifil II, shades B1 and Enamel High-Value Translucent.

Photos: Frank J. Milnar, DDS, AAACD

REESTABLISHING PINK AND WHITE ESTHETICS THE GIOMER WAY

Modern patients are well informed and demand highly esthetic yet minimally invasive and affordable solutions. To address the evergrowing needs of the patients, general practitioners seek products that are not only clinical problem-solvers but also have the ability to expand the range of treatment techniques in a simple and cost-effective manner.

Developed as a functional extension to the existing **Beautiful II** line, the gingiva- and enamel-colored composites provide general practitioners with the ability to offer highly esthetic and long-lasting restorations more efficiently and at a lower cost.

- highly filled (83 wt%)
- excellent flexural and compressive strength
- optimal color stability before and after curing
- high luster
- all the benefits of **Giomer technology**



FIG 4. Conservative gingiva addition/reduction in creating natural esthetics using Beautiful II **Gingiva-colored composites** and Lite Touch stain.

Photos: Hugh Flax, DDS, AACD, MICOI

FACILITATING AN ENVIRONMENT FOR LONG-TERM ORAL HEALTH

Dentists who provide restorative care are always seeking materials that demonstrate optimal characteristics. While composite resin materials have become a staple of the dental practice, these materials may present challenges. Reliable long-term bond adhesion has been shown to be difficult to achieve;⁷ polymerization of composites is another challenge.

Flowable composite resins, such as **Beautiful Flow Plus**, have been considered an answer to some of the problems associated with polymerization shrinkage.

BEAUTIFIL FLOW PLUS

- reported to exhibit low polymerization shrinkage with the strength and functionality to meet and surpass leading nano-hybrid composites¹
- fluoride-releasing bioactive injectable flowable resin densely packed with **Giomer** nano-fillers for fracture-free restorations
- two radiopaque viscosities, a sculptable zero-flow F00 and a low flow F03, demonstrate high compressive and flexural strength
- optimal for restoring both anterior and posterior teeth, even cusps and marginal ridges

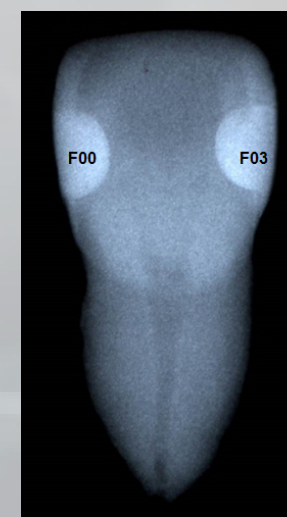


FIG 5. Esthetic reconstruction completed with Beautiful Flow Plus F00, F03, and Beautiful II.

Photos: Jack D. Griffin, DMD, MAGD

FIG 6. High radiopacity of **Beautiful Flow Plus** permits viewing and maintenance of treated areas.

BULK-FILL MATERIALS WITH BIOACTIVE TECHNOLOGY

Traditionally, clinical placement of composite resins has been done using an incremental technique. That is no longer the case—with advances in polymer chemistry, photo-activation, and curing-light technologies, incremental placement is no longer the only available option. However, many modern bulk-fill materials are essentially inert, doing nothing to protect the teeth they are theoretically there to protect.

Giomer-inclusive **Beautiful-Bulk Flowable** (base) and **Beautiful-Bulk Restorative** (final restorative) redefine resin-filling technology by combining the benefits of bulk-fill delivery system with bioactive properties attributed to the proprietary surface pre-reacted glass-ionomer (S-PRG) technology. The ion exchange from **Giomer** fillers helps neutralize acid that leads to tooth demineralization and decay for extended periods of time.⁸



FIG 7. Image (left): **Beautiful-Bulk Flowable** is used to fill the proximal box of a class II cavity preparation. Because of the self-leveling and low viscosity of Beautiful-Bulk Flowable, the geometry of the proximal box is predictably filled without condensation of the material. Image (middle): **Beautiful-Bulk Restorative** is used to complete the occlusal aspect of the restoration. Image (right): An occlusal view of the completed restoration.

Photos: Robert A. Lowe, DDS, FAGD, FICD, FADI, FACD, FIAD, FASDA

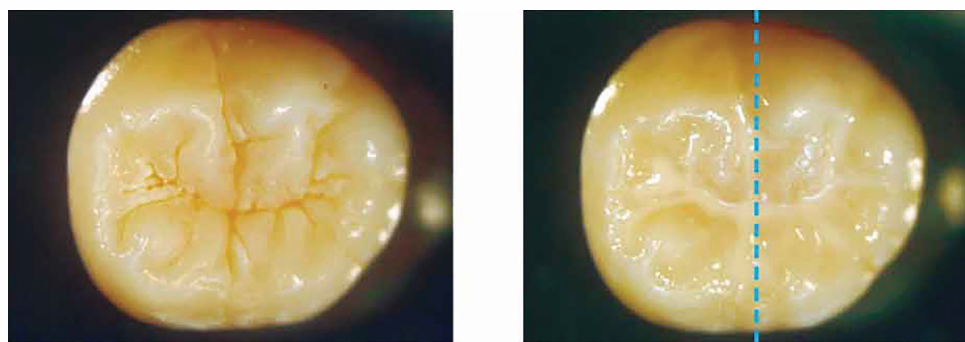
THE TEAM PERSPECTIVE: BIOACTIVE CHEMISTRY IN PREVENTIVE DENTAL CARE

CARIES PREVENTION

Evidence-based clinical recommendations formulated by the American Dental Association and the American Academy of Pediatric Dentistry assert the efficacy of pit-and-fissure sealants in caries prevention.⁹

The development of **BeautiSealant**, a pit-and-fissure sealant with bioactive properties makes the technique even more integral to the fight against tooth decay, permitting the clinicians and hygienists to perform dental care more effectively and with long-lasting results.¹⁰

BeautiSealant thoroughly seals the tooth surface only permitting the fluoride-releasing bioactive S-PRG fillers penetrate into the preparation to create an environment with strong anti-plaque and anti-bacterial attributes.



BeautiSealant thoroughly seals the tooth surface only permitting the fluoride-releasing bioactive S-PRG fillers penetrate into the preparation to create an environment with strong anti-plaque and anti-bacterial attributes.

HYPERSENSITIVITY

Clinical research indicates that the pain and discomfort resulting from dentinal hypersensitivity is a common patient complaint. Usually associated with a strong response to routine stimuli of thermal, tactile, osmotic, chemical or evaporative origin, this chronic condition goes often undiagnosed.¹¹ There are many ways to treat hypersensitivity. One promising in-office treatment for patients suffering from severe dentinal hypersensitivity involves a bioactive varnish with an extended protection time

—**PRG Barrier Coat**.



PRG Barrier Coat can be utilized in a broad range of preventive applications, including desensitizing hard-to-brush zones and areas at high risk of caries.

THE FUTURE OF BIOACTIVE DENTISTRY

COMING SOON

Beautifil II LS (Low Shrink) direct composite. This ground-breaking restorative reports the lowest polymerization shrinkage and shrinkage stress while offering the same clinical benefits of Giomer technology and functional esthetics.



As dentistry continues to evolve toward early prevention and reestablishing functional esthetics as opposed to just providing “beauty” dentistry, concepts such as “bioactive” and “biomimetic” are becoming increasingly important.

Among dental materials available today, **Giomers** stand in a class of their own. They are bioactive—inducing cellular changes at a tissue interface by eliciting apatite formation to improve the resistance of teeth (fluoride and strontium act on hydroxyapatite to convert it into fluoro-apatite and strontium-apatite)—and possess novel physical, mechanical, and optical properties that contribute to improved clinical results and practice profitability.



FIG 9. Shofu has successfully incorporated the **Giomer technology** into a versatile line of products including nano-hybrid composites (packable, injectable, flowable, bulks), cements, adhesive systems, sealant, and light-cured varnish.

Official Partner



REFERENCES

1. Cao W, Hench LL. Bioactive materials. *Ceram Int*. 1996;22(6):493-507.
2. Jeffries SR. Bioactive and biomimetic restorative materials: a comprehensive review. Part I. *J Esthet Restor Dent*. 2014;26(1):14-26.
3. Goldstep F. Proactive intervention dentistry: a model for oral care through life. *Compend Contin Educ Dent*. 2012;33(6):394-402.
4. Milnar F.J. Conservatively recreating a smile. *DentistryToday.com*. February 1, 2016. <http://www.dentistrytoday.com/articles/10154>. Accessed Sept 13, 2016.
5. Gordan VV, Mondragon E, Watson RE, et al. A clinical evaluation of a self-etching primer and a giomer restorative material: results at eight years. *J Am Dent Assoc*. 2007;138(5):621-627.
6. Gordan VV, Blaser PK, Watson RE, et al. A clinical evaluation of a giomer restorative system containing surface prereacted glass ionomer filler: results from a 13-year recall examination. *J Am Dent Assoc*. 2014;145(10):1036-1043.
7. DeMunck J, Van Landuyt K, Peumans M, et al. A critical review of the durability of adhesion to tooth tissue: methods and results. *J Dent Res*. 2005;84(2):118-132.
8. Lowe RA. Advances in composite resin materials. *Inside Dentistry*. 2015;11(12):45-49.
9. Wright JT, Crall JJ, Fontana M, et al. Evidence-based clinical practice guideline for the use of pit-and-fissure sealants. *J Am Dent Assoc*. 2016;147(8):672-682.
10. Burgess JO. Material revolution. *Dimensions of Dental Hygiene*. 2012;10:1-6.
11. Halabo S. Giomer varnish for prolonged hypersensitivity relief. *Oral Health Canada*. 2015;12:8-14.