

Solving color irregularities with a bioactive bulk-fill restorative system: Case report and 24-months follow up.

Resolución de irregularidades de color con un sistema restaurador bulk-fill bioactivo: Reporte de caso y seguimiento de 24 meses.

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Abstract: Bulk-fill resin composites represent an excellent alternative to the conventional incremental layering technique for the reduction of polymerization stress on the adhesive interface. Marginal seal can be further improved by the incorporation of bioactive fillers, such as those encountered in Gioners. However, the high translucency required for the adequate polymerization of bulk-fill materials can seriously jeopardize the final aesthetic outcome of the restorations, especially in the presence of inhomogeneous or stained dentin substrates. The aim of this case report was to present the combined use of two bulk-fill Gioner materials (Beautiful Bulk Flowable and Beautiful II LS, Shofu) for the restoration of three posterior maxillary teeth displaying a black stained dentin substrate due to amalgam corrosion products. This technique allowed completion of the restorations with a satisfactory aesthetic and biomimetic outcome. The adequate preservation of the anatomy and function of the three restorations after 24-months follow-up, provides evidence of the enhanced marginal sealing capacity of these bioactive materials and the success of bulk-fill techniques over time.

Keywords: Bulk-fill resin composite; flowable resin composite; giomer; bioactive filler; tooth discoloration; biomimetic.

Resumen: Las resinas compuestas de tipo bulk-fill representan una excelente alternativa a la técnica incremental para la reducción de la tensión de polimerización sobre la interfaz adhesiva. La incorporación de rellenos bioactivos, como los que se encuentran en los materiales con tecnología giomer, refuerzan aún más el sellado marginal de estas restauraciones. Sin embargo, la alta translucidez, necesaria para la adecuada polimerización de los materiales tipo bulk-fill, puede comprometer seriamente el resultado estético final de las restauraciones, especialmente en presencia de sustratos dentarios no homogéneos u oscurecidos. El objetivo de este reporte de caso fue presentar el uso combinado de dos materiales giomer tipo bulk-fill (Beautiful Bulk Flowable y Beautiful II LS, Shofu) para la restauración de tres dientes maxilares posteriores con un sustrato dentinario ennegrecido debido a productos de corrosión de amalgama.

Esta técnica permitió completar las restauraciones con un resultado estético y biomimético satisfactorio. La adecuada conservación de la anatomía y la función de las tres restauraciones tras un período de 24 meses, aporta evidencia sobre la adecuada capacidad de sellado

marginal de estos materiales bioactivos y el éxito de las técnicas de restauración tipo bulk-fill en el tiempo.

Palabra Clave: Resina compuesta bulk-fill; resina compuesta fluida; giomer; relleno bioactivo; decoloración de dientes; biomimética.

INTRODUCTION.

Since their introduction in the early 1970's, resin composites have experienced a continued evolution, allowing significant improvements in their mechanical and optical properties, while reducing the negative consequences of polymerization shrinkage.¹ However, their clinical success is still highly dependent upon a correct application technique. Due to the difficulties encountered in the polymerization of large increments and the risk of high polymerization stress on the cavity margins,²⁻⁴ the incremental layering technique has become the gold standard for the restoration of posterior teeth.

On the other hand, the recent introduction of so-called bulk-fill resin composites has provided an interesting alternative to deal with aforementioned issues. These materials have proven to effectively minimize stress development during polymerization,³ as well as to increase the degree of conversion of the material,^{5,6} even in large increments up to 4-5 mm.³ A considerable reduction in the working times is thus obtained, while reducing the sensitivity of the application technique. Despite their promising initial outcomes in both, *in vitro*^{3,5} and *in vivo* studies,⁶⁻⁸ the broad use of bulk-fill restorations is still controversial and subjected to special considerations. Among them, the high translucency of these material, necessary to ensure an adequate light transmission during polymerization,⁹ has raised concern, especially when masking of a dark dentin substrate is needed.¹⁰

In parallel to bulk-fill restorations, development of bioactive resin composites has also gained relevance in the last decade. Of special interest are giomers, where the incorporation of surface pre-reacted glass-ionomer (S-PRG) fillers allow a sustained release of fluoride and other ions,¹¹ favoring remineralization of dental substrates and granting protection against secondary caries at the restoration margins.^{11,12} Giomers are considered, therefore, a promising alternative for the restoration of caries affected teeth.

The aim of this case report was to present the combined use of two giomer materials for the restoration of three posterior maxillary teeth displaying a black stained dentin substrate due to amalgam corrosion products.

CASE REPORT

A healthy 36-year old female patient attended the private praxis of the authors for the replacement of three amalgam restorations in the maxillary left first and second premolars (teeth 2.4 and 2.5) and the maxillary left first molar (tooth 2.6), due to important material corrosion and deterioration (Figure 1).

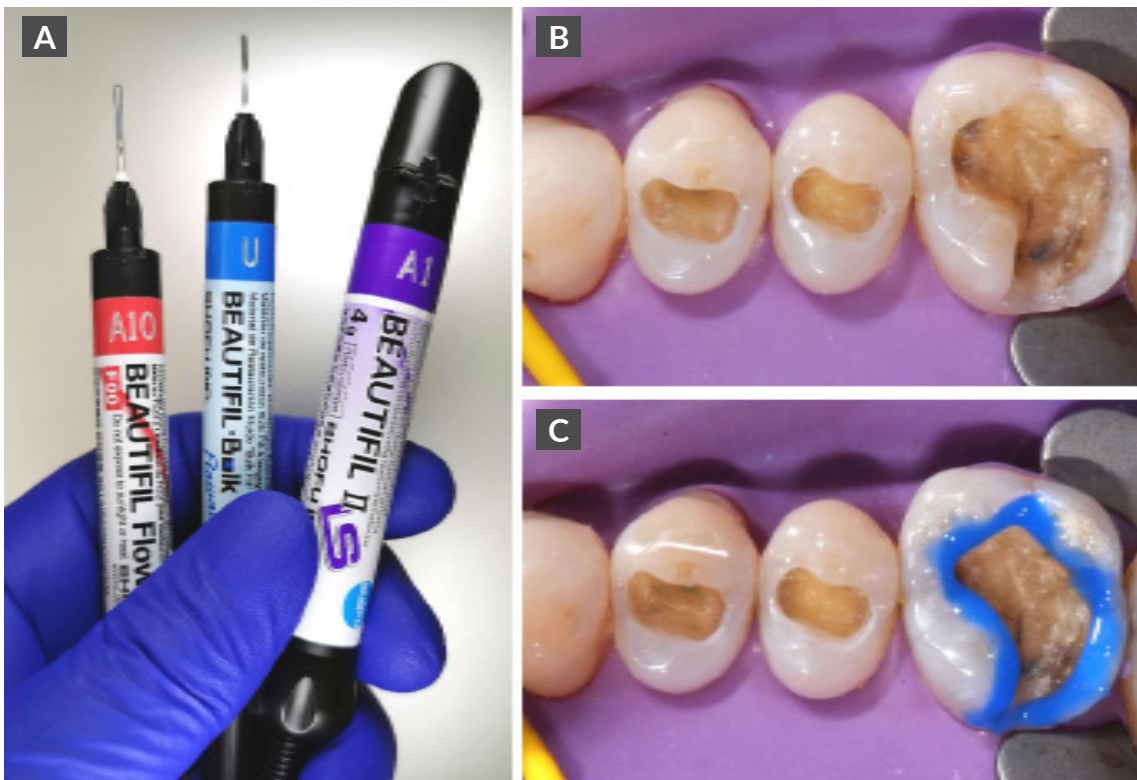
After clinical examination, complemented with intraoral photographs and radiographs, all three teeth were found vital and displayed a slight rotation, with minor wear facets in the buccal cusps of 2.4 and 2.6. Amalgam restorations showed an advanced stage of corrosion, with deficient occlusal anatomy, marginal deterioration and important dark discoloration of the surrounding enamel and dentin substrates. Therefore, replacement of the three amalgams with direct resin composite was indicated. In the case of 2.6, where the old restoration covered a large portion of the occlusal table and the complete disto-palatal cusp, this conservative approach was preferred over an indirect technique, due to the favorable occlusal conditions and the integrity of both marginal ridges. In order to optimize the intervention, the restorations were planned under the bulk-fill concept, permitting their completion in only one clinical session.

Amalgam removal was conducted under a non-latex rubber dam isolation by using transmetal burs (Talon, Tri-Hawk, Morrisburg, Ontario, Canada) and abundant water irrigation. Strong black stained areas were visible in the underlying dentin (Figure 2B), due to amalgam corrosion products,¹³ especially in the cavity floor of tooth 2.6. Masking over removal of this sound dentin was decided, following the minimal intervention philosophy. Selective etching with 35% phosphoric acid (Ultra-Etch,

Figure 1. Initial situation. Amalgam restorations in teeth 2.4, 2.5 and 2.6 displayed an advanced stage of corrosion, with deficient occlusal anatomy, marginal deterioration and an important dark discoloration of the surrounding enamel and dentin substrates.

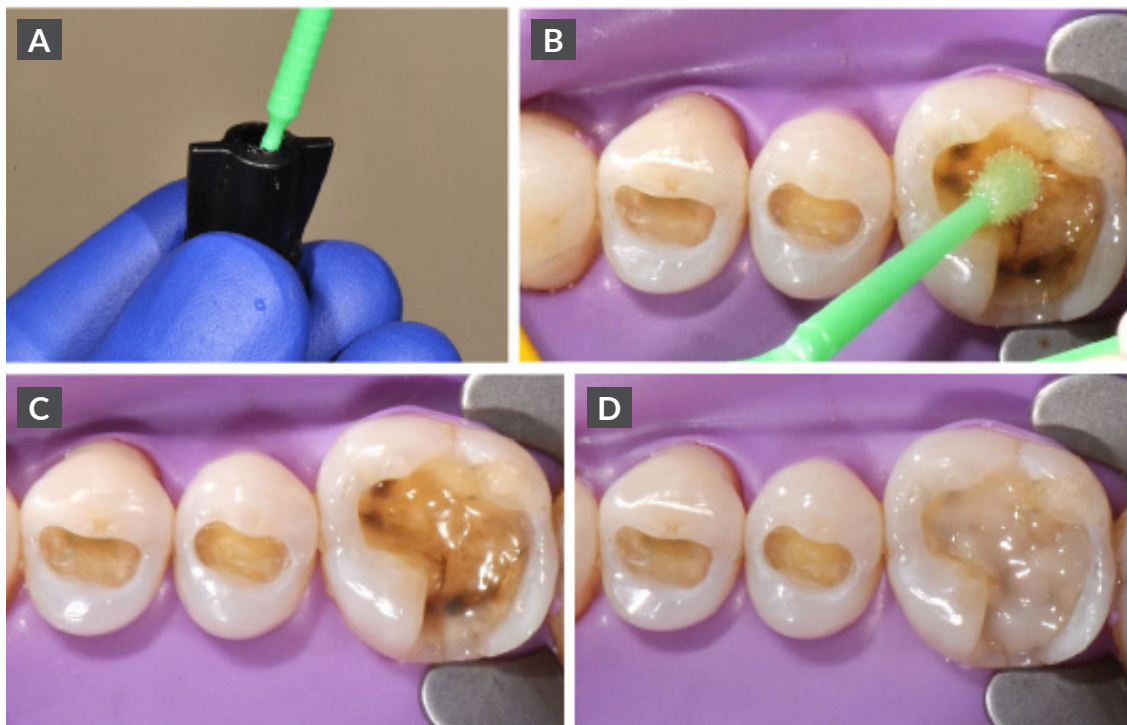


Figure 2. Giomer resin composites and tooth preparation.



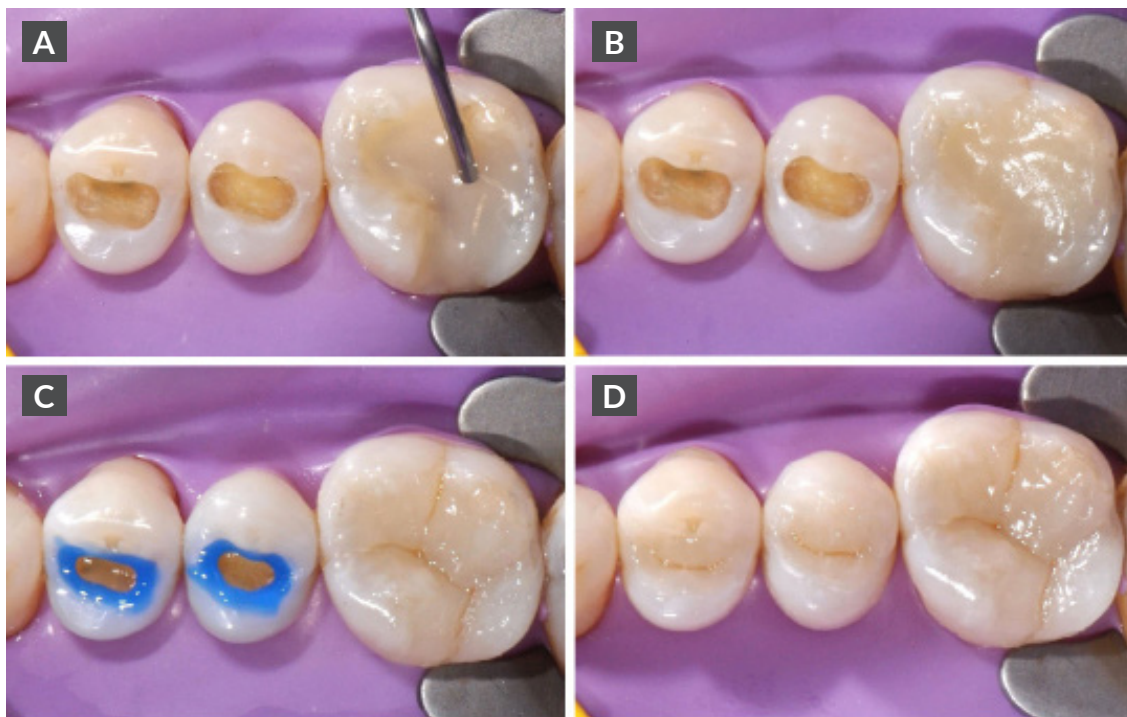
A: From left to right; Beautifil Flow Plus F00 shade A10, Beautifil Bulk Flowable shade Universal and the low shrinkage Beautifil II LS shade A1. **B:** Tooth preparations after amalgam removal. Black stained areas were observable in the underlying dentin. **C:** Selective etching of the enamel margins with 35% orthophosphoric acid.

Figure 3. Bonding and substrate masking.



A: Beautibond Universal Adhesive, unit dose. **B:** Active application of the adhesive on the cavity floor and walls. **C:** Enamel and dentin appearance after the bonding technique in tooth 2.6. Black stained areas were still visible. **D:** After application of an opaque flowable resin composite, color irregularities were masked in tooth 2.6.

Figure 4. Restorative procedure.



A: Injection of a 3 mm thick layer of Beautifil Bulk Flowable resin composite, shade Universal. **B:** Insertion of a single increment (1.3 - 1.5 mm) of the low shrinkage resin composite Beautifil II LS, shade A1. **C:** Occlusal morphology and characterization of tooth 2.6 after light-curing. The same procedure was repeated step by step for teeth 2.4 and 2.5. **D:** Appearance of the restorations before polishing.

Figure 5. Recall.



A: 12-month. B: 24-month follow-up. Margins and surface gloss were well preserved. The restorations displayed good color stability.

Ultradent, South Jordan, UT, USA) was applied to the enamel for 15 s (Figure 2C) and then thoroughly washed with water-air spray for the same amount of time. After drying with absorbent paper points, the universal adhesive Beautibond (Shofu, Kyoto, Japan) was applied with a microbrush to the cavity walls and floor (Figure 3A and Figure 3B).

After a 30 s solvent evaporation time, excess adhesive was removed with a new microbrush and by gently air blowing. The adhesive was then light-cured with a LED lamp (Valo, Ultradent) for 20 s. Despite the glossy appearance of the floor cavity (Figure 3C), black stained areas were still visible, compromising the aesthetics of the future restoration. Therefore, a thin layer of opaque flowable resin composite (Beautiful Flow Plus F00, shade A1O, Shofu) was selectively applied to these areas, as depicted in Figure 3D.

After light-curing, a 3 mm thick layer of the bulk-fill resin composite Beautiful Bulk Flowable (Shofu) was injected to the entire cavity, leaving 1.5 mm of space from the margin for the occlusal layer,¹⁴ as shown in Figure 4A. Polymerization of the bulk-fill material was conducted at 1000 mW/cm² for 20s. The occlusal morphology was sculpted using the low shrinkage Beautiful II LS (Shofu),

shade A1, by inserting a single increment with the composite 7 spatula (American Eagle, Missoula, USA) and ensuring good adaptation to the cavity margins (Figure 4B). Occlusal sulci and cusp ridges were modelled with the composite 1 instrument (American Eagle) and then light-cured for 20 s (Figure 4C).

Further characterization was achieved by applying a small amount of a light-brownish flowable resin (LiteArt, Shofu) inside the grooves, followed by 40 s light-curing. A glycerine gel (Liquid Strip, Ivoclar-Vivadent, Schaan, Liechtenstein) was used to prevent the oxygen-inhibition layer. The same procedure was repeated for the restorations of teeth 2.5 and 2.4. After rubber-dam removal, occlusion was adjusted using fine grain diamond burs, followed by aluminium oxide polishers (One Gloss, Shofu). Final gloss was obtained with diamond polishers (Diatech ShapeGuard, Coltene, Alstätten, Switzerland), at 8,000 RPM (Figure 4D).

Follow up controls were conducted at 12 and 24 months (Figure 5), including clinical and radiographic examination. Restorations were well preserved over the entire period, with no signs of marginal deterioration or secondary caries, and displaying glossy surfaces and good color stability.

DISCUSSION.

Secondary caries have been reported as the main cause for failure in posterior resin composites.¹⁵ Their occurrence is a direct consequence of marginal leakage and adhesive bond loss. Therefore, the use of bioactive resin composites, able to chemically bond to the dentin substrate and favor its remineralization,¹² represent an excellent alternative to face this problem. With this goal in mind, two giomer resin composites were used for the resolution of the current case. The addition of the remineralization capacity of glass ionomer fillers to the enhanced mechanical and aesthetic properties of resin composites,^{11,16} has proven to have a good clinical performance, with low caries recurrence¹⁷ and long-term stability.¹⁸

In addition, the introduction of stress compensation mechanisms in bulk-fill materials has proven to be effective in reducing stress development on the adhesive interfaces during material polymerization,³ and thus, contributing to the reduction of micro- and nanoleakage on the restoration margins. Furthermore, the increased depth of cure displayed by these materials allow their application in large increments (up to 4 mm),⁵ reducing working times and eliminating disadvantages associated with incremental techniques.

On the other hand, one of the main limitations of bulk-fill materials is their high translucency,¹⁰ which is critical when dark discoloration of the substrate needs to be masked.^{13,19} Here, the use of an opaque flowable resin resulted to be an excellent alternative to cover the stained dentin areas, allowing an acceptable biomimetic result without sound tissue removal. Subsequent application of a bulk-fill flowable resin composite aimed to improve material adaptation to the cavity floor and to reduce polymerization shrinkage effects on the adhesive interfaces.²⁰ However, due to the low filler content and low viscosity of flowable materials, a final 1.5 mm layer of a regular resin composite was applied to allow the correct modelling of the occlusal morphology. Thus, the final aesthetic outcome of the restorations responded to both, the biomimetic occlusal patterns created and the good polishability of the material.

CONCLUSION.

The combined use of bulk-fill flowable and regular resin composites enabled the complete restitution of the anatomy and function of three posterior teeth.

Aesthetic limitations of the bulk-fill material were successfully overcome with the application of an opaque masking material on the cavity floor. The use of giomer technology contributed to the good stability of the restorations at the 24 months follow up.

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