

Glass- Hybrid Restorations

FOR LONG-TERM SUCCESS

Product Evolution

Gaurav Joshi, BDS, PhD;
Mark Heiss, DDS

Pediatric Clinical Cases

Lance Kisby, DMD

Adult Clinical Cases

Mark L. Pitel, DMD



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**Once again,
innovative
product
development is
making the
dentist’s job
easier and
helping to
improve patient
outcomes.**

Building on Success

In dentistry, new product development is all about helping dentists serve their patients better. This clearly was one of the motives behind the development of GC America’s newest member of its clinically proven EQUIA® family of products, EQUIA Forte® HT. The manufacturer, which is celebrating its 100th anniversary this year, has a long and notable history in developing glass-ionomer dental restoratives. This product, a bulk-fill glass-hybrid long-term restorative system introduced in 2019, builds on that success.

I have been privileged to work with the GC team for a number of years and am honored that they’ve asked me to introduce this special supplement to *Compendium*. It describes the glass-hybrid technology used to create this new restorative system, which provides enhanced mechanical properties, increased fluoride release, excellent handling, and improved translucency. Case examples demonstrating glass-hybrid restorations in pediatric patients and in permanent posterior teeth are also provided.

Offering better esthetics than past versions of EQUIA, this latest restorative product is durable and versatile. EQUIA Forte HT can be used in children, adults, geriatric patients, and high-risk caries patients due to its glass-hybrid technology that features intelligent particle size distribution and a synergistic coat. For the clinician, it handles extremely well, making daily restorative work easy and efficient. It eliminates the need for rubber dam placement and adhesive application, and a new easy-to-use dispensing unit allows for convenient one-hand use.

Once again, innovative product development is making the dentist’s job easier and helping to improve patient outcomes. I hope clinicians will find this publication useful as they strive to provide their patients the best dentistry they possibly can.

Sincerely,

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FOR LONG-TERM SUCCESS

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Glass-Hybrid Technology for Long-Term Restorations

Gaurav Joshi, BDS, PhD; and Mark Heiss, DDS

Glass-ionomer restoratives exhibit several unique characteristics such as moisture tolerance, chemical adhesion to tooth, and fluoride release. Since their introduction some 50 years ago, these materials have continuously improved in terms of mechanical properties and setting time. However, their clinical application is typically limited to restoring non-stress-bearing areas. Clinical studies have shown that glass ionomers have lower early wear resistance, but they exhibit similar long-term wear as composite resins.^{1,2} Thus, the need arose for an innovative restorative system that improved early physical properties while maintaining the unique advantages of glass ionomers to allow for a wider use of the material.

Glass-Hybrid Technology and Its Evolution

In 2007, the EQUIA® restorative system (GC America Inc, gcamerica.com) was developed, consisting of EQUIA® Fil, a self-adhesive bulk-fill material, and EQUIA® Coat, a highly filled resin coating. This system expanded clinical indications to include Class I and Class II preparations. The new glass-hybrid technology was featured in a later version, EQUIA Forte®, and subsequently in EQUIA Forte® HT. In glass hybrids, the conventional glass matrix is reinforced with ultrafine and highly reactive glass particles. In addition, the inclusion of high-molecular-weight polyacrylic acid further improves the mechanical properties and handling (Figure 1). The particle size distribution was also optimized to allow for prolonged working time, which allows clinicians enough time to

place the restorations without affecting the procedure time. The newest glass hybrid features a higher translucency than its predecessors for achieving improved esthetics (Figure 2).

Protective Resin Coat

EQUIA Forte® Coat is a self-adhesive, nanofilled resin that protects and improves the physical properties of the underneath restoration. The coat contains 40-nm silica fillers and uses a filler-dispersion technology that ensures the uniform repartition of the fillers, preventing any agglutination (Figure 3). In addition to moisture protection, the 35- to 40-µm-thick coat provides additional wear resistance to the restoration in its early stages. The resin coat infiltrates pores and irregularities on the surface of the restoration, rendering it strong, smooth, and glossy.

After initial application, EQUIA Forte Coat will wear off after approximately 6 months. Shimada et al showed that the glass hybrids undergo secondary maturation after the coating is removed because of the absorption

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The particle size distribution was optimized to allow for prolonged working time.”

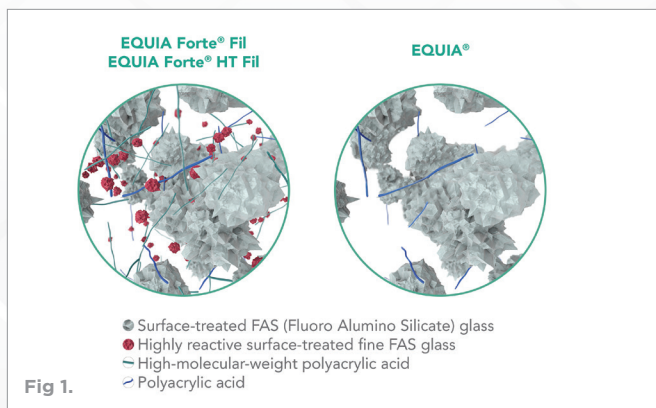
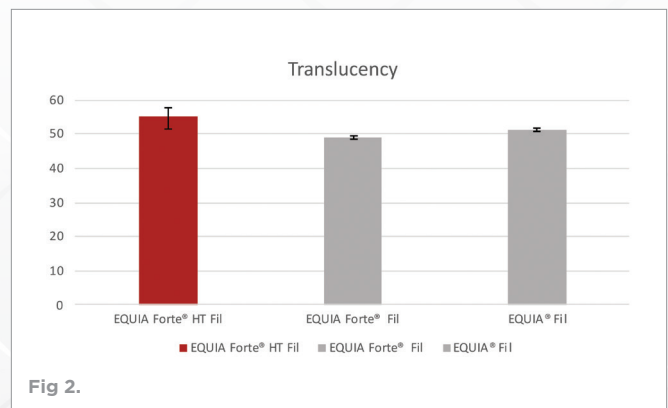


Fig 1. Schematic diagram illustrating the glass-hybrid technology in EQUIA Forte Fil and EQUIA Forte HT Fil and how it differs from EQUIA Fil.
Fig 2. Translucency in different generations of glass hybrids.



of calcium ions from saliva.³ As a result, there is a substantial increase in surface hardness of the restoration (Figure 4), leaving a potentially more wear-resistant restoration.

In Vitro Studies

Multiple in vitro studies have validated the improvement in physical and mechanical properties of glass hybrids. Moshaverinia et al proved that EQUIA Forte showed significantly higher compressive strength and microhardness than conventional glass ionomers.⁴ Moreover, the glass hybrid exhibited significantly improved mechanical properties upon 1 week of immersion in distilled water. Mori et al evaluated the compressive strength of EQUIA Forte HT at different time intervals and compared to conventional glass ionomers.⁵ EQUIA Forte HT showed the highest compressive strength at each time interval. EQUIA Forte HT also exhibited higher translucency than its predecessors.⁶

Clinical Implications

The longevity of posterior EQUIA restorations has been proven in many independent, long-term clinical studies.⁷⁻¹¹ Gurgan et al evaluated the durability of EQUIA restorations in Class I and Class II cavities over a 10-year period; the study found that the success rate was 100% and the cumulative failure rate was 3.17%.⁷

Miletic et al compared the clinical performance of a glass-hybrid restorative system with that of a nanohybrid resin composite in 360 moderate to large Class II restorations in a split-mouth, multi-centered randomized clinical study.¹² The study found that there were no significant differences in the survival rates between the two materials, and the survival rate for EQUIA Forte was 93.6% at 2-year follow-up. With improved properties of the next-generation glass hybrid, EQUIA Forte HT is expected to produce even better clinical outcomes.

DISCLOSURE

The authors are employees of GC America Inc.

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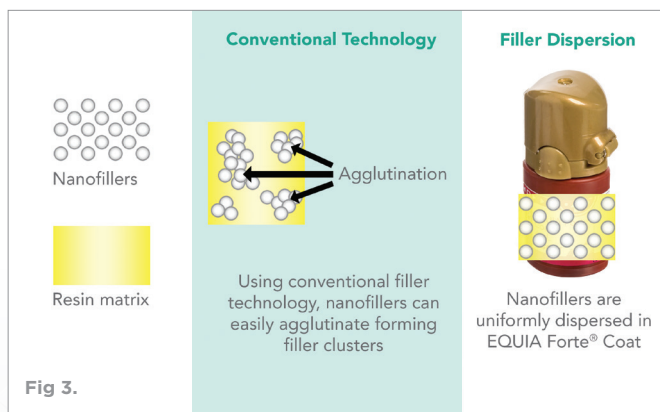


Fig 3.

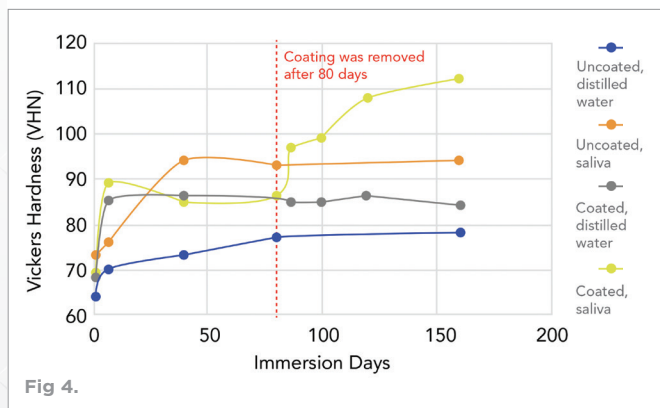


Fig 4.

Fig 3. Filler dispersion technology in EQUIA Forte Coat. **Fig 4.** Secondary maturation phenomenon seen after removal of coating.

Glass-Hybrid Restorations in Pediatric Patients

Lance Kisby, DMD

Glass-ionomer cements (GICs) are self-adhesive bulk-fill dental restorative materials. As reported in 1971 by Wilson and Kent,¹ GICs failed to gain acceptance due to poor wear resistance and an inability to perform well on posterior teeth.²

In 2014, GC Corporation introduced EQUIA Forte®, the first glass-hybrid technology indicated for stress-bearing Class II restorations. In 2019, the company introduced the high-viscosity GIC EQUIA Forte® HT Fil, which featured improved translucency and was indicated for stress-bearing and non-stress-bearing Class I and Class II restorations as well as Class V restorations. The following

cases demonstrate the advantages of EQUIA Forte® HT compared to EQUIA Forte.

Case 1: EQUIA Forte in a Primary Canine

A 6-year-old patient with poor cooperation presented with facial caries on tooth No. H (Figure 1). After the caries was removed, a bond surface conditioner (Cavity Conditioner, GC America Inc) was applied to the area for 10 seconds, rinsed for 10 seconds, and then dried but not desiccated. EQUIA Forte was placed, allowed to set, and EQUIA Forte® Coat was then applied and light-cured (Figure 2).



Fig 1. Facial caries on tooth No. H in a 6-year-old patient. **Fig 2.** Post-caries removal, application of Cavity Conditioner, EQUIA Forte Fil, and EQUIA Forte Coat. **Fig 3.** One-year follow-up. Note imprecise color match.



Fig 4. Caries on the distal pit of tooth No. J. **Fig 5.** Conservative preparation. **Fig 6.** After EQUIA Forte HT Fil and EQUIA Forte Coat application. Note precise color match.

After 1 year (Figure 3), the restoration had held up well, but the color did not match.

Case 2: EQUIA Forte HT Fil on Tooth No. J

Caries was present on the distal pit of tooth No. J (Figure 4). Because an adhesive is not needed when using EQUIA Forte HT Fil, dental visits for pediatric patients can be shorter. Additionally, the material's ability to release fluoride into enamel and dentin is beneficial for all pediatric patients but especially for those at risk for dental caries.

A conservative preparation was done (Figure 5). The EQUIA Forte HT Fil capsule was mixed for 10 seconds, and the material was syringed into the preparation within 10 seconds, condensed, and contoured. After 2 minutes and 30 seconds of mixing, EQUIA Forte Coat was applied and light-cured (Figure 6); as can be seen, the material matched the tooth color well.

Case 3: EQUIA Forte HT on Tooth No. 4 DO

EQUIA Forte HT is also an appropriate restorative material for permanent teeth. In this case, tooth No. 4 was treated with a distal-occlusal (DO) slot preparation (Figure 7). EQUIA Forte HT Fil was mixed, placed, and contoured, and EQUIA Forte Coat was applied and light-cured (Figure 8). The excellent color match and the material's ability to take on the color of the tooth structure around it was evident.

Discussion

EQUIA Forte HT Fil is a stronger restorative material for primary and permanent teeth with a better color match than its predecessor.³ EQUIA Forte Coat makes the surface smooth, increases wear resistance, and creates a harder GIC from secondary maturation within 24 hours.⁴

Basso et al exhibited that at 7 years, Class I EQUIA restorations showed no failures and Class II restorations were 70% successful.⁵ In a 4-year study comparing EQUIA and resin composites, Gurgan et al reported that EQUIA had one failure at years 3 and 4 and none at year 5.⁶ Also, Gurgan et al showed at 10 years a cumulative failure rate of only 3.17% for both Class I and Class II restorations. There was no significant change in anatomical form, secondary caries, postoperative sensitivity, surface texture, or retention.⁷

EQUIA Forte HT Fil offers increased strength and better esthetics than EQUIA for primary and permanent teeth. This demonstrates that a glass-hybrid GIC is a viable long-term restorative material.



EQUIA Forte HT Fil offers increased strength and better esthetics than EQUIA for primary and permanent teeth.



Fig 7.



Fig 8.

Fig 7. Tooth No. 4 treated with a DO slot preparation. **Fig 8.** After restoration with EQUIA Forte HT Fil and EQUIA Forte Coat. Again note the excellent color match.

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Long-Term Performance of Glass-Hybrid Restorations in Permanent Posterior Teeth

Mark L. Pitel, DMD

Since their introduction in the early 1970s, glass-ionomer cements (GICs) have been broadly accepted for clinical applications such as crown buildups, cementation, and bases under fillings. However, their acceptance as a direct restorative material has been limited comparatively speaking, especially for permanent posterior teeth. This is due primarily to the perception that GICs are not as esthetic or durable as composite resin materials. Dentists tend to restrict their use of GIC to primary teeth, geriatric applications, and other

clinical situations where patients exhibit poor oral hygiene or where a high level of fluoride release is desirable. Surprisingly, clinical studies have shown that while GICs do have a higher initial wear versus composites, they exhibit very similar long-term wear and retention over extended periods.¹

In 2009, a new restorative technique was introduced to help address the high initial wear rate of GICs and that offered improved esthetics. The technique combined a fast-setting, high-viscosity type II GIC material (EQUIA[®] Fil, GC America) and a light-cured,

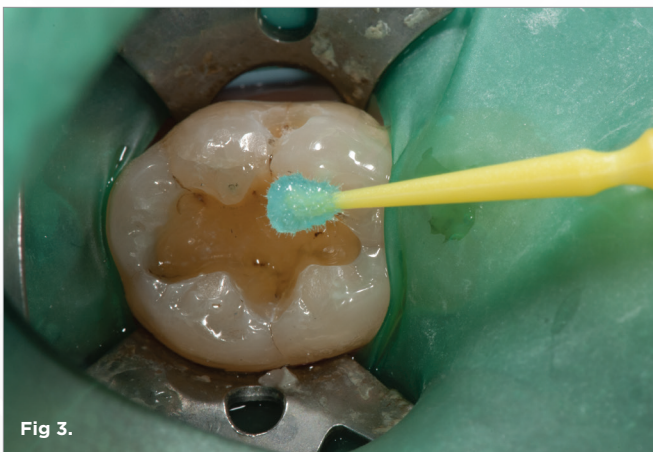


Fig 1. Preoperative view of defective Class I and Class V amalgam filling in mandibular right first molar (tooth No. 30). **Fig 2.** Rubber dam was applied, defective fillings removed, and final Class I and Class V cavity preparations completed. **Fig 3.** Cavity preparations were cleaned with 20% polyacrylic acid (Cavity Conditioner, GC America) for 10 seconds and rinsed with water. **Fig 4.** High-viscosity glass restorative (EQUIA Fil) was mixed and injected directly into cavity using bulk-fill technique and allowed to set for 2 minutes and 30 seconds.

nanofilled resin coating (EQUIA[®] Coat, GC America) to form a hybrid restoration. The resin coating filled any small surface defects, significantly improving mechanical properties, reducing wear and the likelihood of void and crack formation, and producing a smoother, more plaque-resistant surface than previous GIC restoratives.²

Initially, EQUIA Fil restorations were recommended for Class I, Class II, and Class V restorations but were restricted to



GICs exhibit similar wear and retention to composites over extended periods.

non-stress-bearing applications. Used clinically in these situations, the materials and technique produced esthetically pleasing and durable direct esthetic restorations.^{3,4} Some studies even reported 5-year survival rates for Class I EQUIA restorations close to 100%.⁵ While Class II survival rates were lower, they were still favorable overall.

Class I EQUIA Restoration

Figure 1 through Figure 8 document a typical Class I EQUIA restoration in tooth No. 30, starting from its initial placement more than 10 years ago in 2009. Using Modified United States Public Health Service (USPHS) criteria for clinical evaluation,⁶ the 10-year recall of the EQUIA restoration (Figure 8) would be rated “Alpha” in all categories except surface roughness and luster

(ie, Alpha = explorer does not catch or has one-way catch when drawn across the restoration/tooth interface; general contour of the restorations follows the contour of the tooth; there is no discoloration between restoration and tooth; contacts are normal; there is no clinical diagnosis of caries).



Fig 5. After occlusal equilibration, light-cured resin (EQUIA Coat) was applied and light-cured for 20 seconds. **Fig 6.** Completed Class I EQUIA restoration, immediate postoperative. **Fig 7 and Fig 8.** Five-year recall (Fig 7) and 10-year recall (Fig 8), Class I EQUIA restoration No. 30.

CASE EXAMPLES

It is also noteworthy that this case received the light-cured resin coating only once at initial placement. According to the manufacturer, the coating is expected to last from 6 months to 1 year and may be reapplied at any point the clinician feels it would be helpful. Reapplication in this case could likely restore the 10-year-old glass-hybrid restoration to “Alpha” in all USPHS evaluation criteria.

Second Generation

Based on the early clinical success of EQUIA, a second generation of both the glass restorative and resin coating were developed with an even higher flexural strength, greater fluoride release, and improved resistance to wear and acid. Introduced in 2014 EQUIA Forte® Fil and EQUIA Forte® Coat are indicated for unrestricted use in Class V cavities and stress-bearing Class I and Class II posterior restorations. Like all glass restoratives, EQUIA Forte has an unlimited depth of cure, allowing it to be used with a true bulk-fill technique. As such, EQUIA Forte restorations offer an esthetic, high-strength alternative to amalgam, composites, and compomers. Like the earlier version of EQUIA, EQUIA Forte also has shown excellent clinical outcomes.⁷

Class II EQUIA Forte Restoration

Figure 9 through Figure 16 document a stress-bearing Class II mesial-occlusal-distal (MOD) EQUIA Forte restoration on tooth No. 4 placed initially in 2015, and followed for approximately 5 years. Figure 16 shows the 5-year recall of the EQUIA Forte restoration. As evaluated according to USPHS criteria, this restoration would be rated “Alpha” for all categories except surface luster.

While the EQUIA Forte restoration is esthetically acceptable, it appears slightly more opaque than the original EQUIA and comparable composite resin fillings. Because of this, a third generation of EQUIA, which possesses higher levels of translucency and even higher physical properties, was released in 2019. EQUIA Forte® HT is expected to perform even better clinically than earlier generations while yielding superior esthetics.

A Favorable Solution

The COVID-19 pandemic has generated concerns about the risk of infection through aerosols generated in dental procedures. Self-adhesive materials, such as EQUIA Forte HT, can be used in minimally invasive procedures, reducing the risk of aerosol generation.⁸



Fig 9. Preoperative view of defective MOD composite resin restoration in maxillary right second premolar (tooth No. 4). **Fig 10.** Rubber dam was applied, filling removed, and sectional matrices, wedges, and tension rings placed. **Fig 11.** Polyacrylic acid was applied to clean and condition the cavity. **Fig 12.** Second-generation high-viscosity glass restorative material (EQUIA Forte Fil) was injected into the prepared cavity.

The pandemic has also resulted in increased reports of stress-related disorders such as bruxism. The improved mechanical properties of these new materials can prove to be helpful in these situations.⁷⁹

In conclusion, the long-term clinical results of the EQUIA series of materials have shown that direct glass restoratives compare favorably to composite resins in many situations, including the stress-bearing areas of adult posterior teeth.

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Fig 13. After rubber dam was removed, the EQUIA Forte restoration was equilibrated. **Fig 14.** Second-generation light-cured resin glaze (EQUIA Forte Coat) was applied to the new restoration. **Fig 15.** Immediate post-treatment view of the stress-bearing Class II EQUIA Forte MOD restoration. **Fig 16.** Five-year recall, Class II EQUIA Forte MOD restoration No. 4.



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